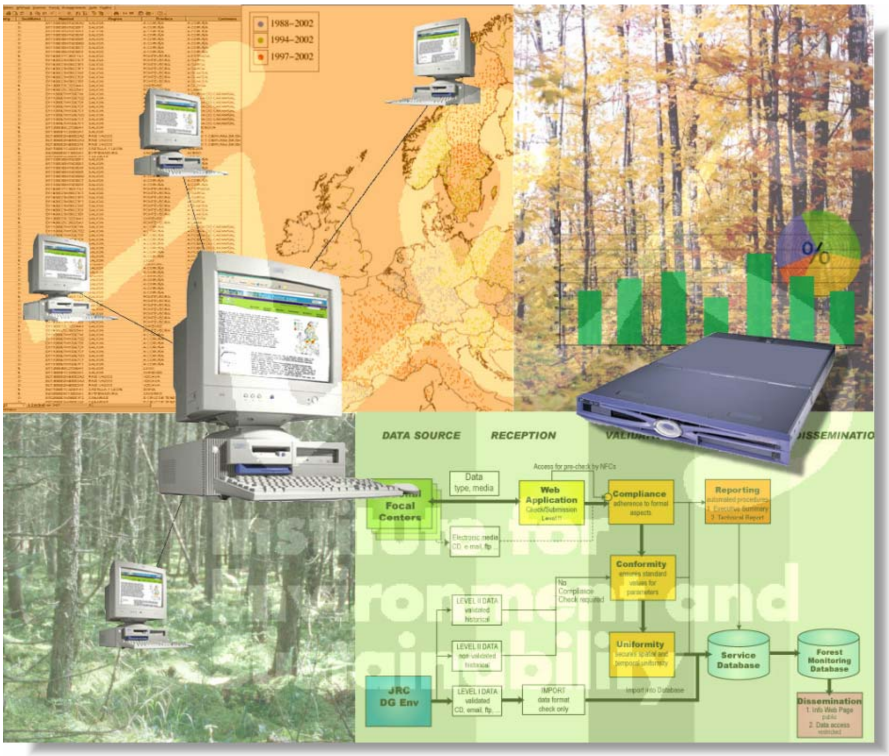
Forest Focus Monitoring Database System

TECHNICAL REPORT
2003 LEVEL II DATA

Hiederer, R., T. Durrant, O. Granke, M. Lambotte,
M. Lorenz, B. Mignon, K. Oehmichen



PUBSY ID – EUR 22905 EN/1

2007

EUROPEAN COMMISSION

MISSION OF THE INSTITUTE FOR ENVIRONMENT & SUSTAINABILITY

The mission of the Institute for Environment and Sustainability is to provide scientific-technical support to the European Union's Policies for the protection and sustainable development of the European and global environment.

European Commission
DG Joint Research Centre
Institute for Environment and Sustainability (IES)
I-Ispra (VA)
Tel.: +39 0332 78 95 14
e-mail: forestfocus-data@jrc.it

This document was prepared under contract of

European Commission DG Joint Research Centre
Institute for Environment and Sustainability
via Fermi, 1
21020 Ispra (VA)
Italy

Under contract

Service Provision for Forest Focus Data Management Action

Contract No.: 380585 F1SCA

I-MAGE Consult
rue de Gembloux 122
B-5002 St-Servais (Namur)
Belgium
http://www.i-mage.be/
Contact: Michel Lambotte, m.lambotte@i-mage.be

Nouvelles Solutions Informatiques s.a. (NSI)
Chaussée de Bruxelles, 174A
B-4340 Awans
Belgium
http://www.nsi-sa.be
Contact: Bertrand Mignon, B.Mignon@nsi-sa.be

Bundesforschungsanstalt für Forst- und Holzwirtschaft (BFH)
Leuschnerstraße 91
D-21031 Hamburg
Germany
http://www.bfafh.de/indexe.htm
Contact: Oliver Granke, o.granke@holz.uni-hamburg.de

This document may be cited as follows:

Hiederer[1]. R. T. Durrant[1], O. Granke[4], M. Lambotte[2], M. Lorenz[4], B. Mignon[3,] K. Oehmichen[3] (2007) Forest Focus Monitoring Database System – Technical Report 2003 Level II Data., EUR 22905 EN/1, 145pp. Office for Official Publications of the European Communities, Luxembourg.

[1]European Commission Joint Research Centre
Institute for Environment and Sustainability
via Fermi, 1
21020 Ispra (VA)
Italy

[2]I-MAGE Consult
rue de Gembloux 122
B-5002 St-Servais (Namur)
Belgium

[3]Nouvelles Solutions Informatiques s.a. (NSI)
Chaussée de Bruxelles, 174A
B-4340 Awans
Belgium

[4]Bundesforschungsanstalt für Forst- und Holzwirtschaft (BFH)
Leuschnerstraße 91
D-21031 Hamburg
Germany

Forest Focus Monitoring Database System

TECHNICAL REPORT 2003LEVEL II DATA

Hiederer. R., T. Durrant, O. Granke, M. Lambotte,
M. Lorenz. B. Mignon, K. Oehmichen

PUBSY ID - EUR 22905 EN/1 - ISSN 1018-5593

Table of Contents

List of Tables

List of Figures

List of Acronyms and Abbreviations

CODE	DESCRIPTION
ASCII	American Standard Code for Information Interchange
BFH	Federal Research Centre for Forestry and Forest Products Bundesanstalt für Forst- und Holzwirtschaft
BLOB	Binary large object
CLRTAP	Convention of the Long-Range Trans-boundary Air Pollution
dbh	Diameter at breast height
DAR	Data-Accompanying Report
DG AGRI	Agriculture Directorate General
DG ENV	Environment Directorate General
JRC	European Commission Joint Research Centre
DSM	Data Submission Module
EC	European Commission
EU	European Union
FFMDb	Forest Focus Monitoring Database
FIMCI	Forest Intensive Monitoring Coordinating Institute
ICP Forests	International Cooperative Programme on Assessment and Monitoring of Air Pollution Effects on Forests
IES	Institute for Environment and Sustainability
LM&NH	Land Management & Natural Hazards Unit
NFC	National Focal Centre
NSI	Nouvelles Solutions Informatiques s.a.
PCC	Programme Coordinating Centre
PDF	Portable Document Format
UN-ECE	United Nations Economic Commission for Europe
XML	Extended Mark-up Language

List of Survey Codes

Code	Survey Name
AQ	Air Quality
CC	Crown Condition
DP	Deposition
FO	Foliar Chemistry
GR	Growth and Yield
GV	Ground Vegetation
LF	Litterfall
MM	Meteorology
OZ	Ozone Injury
PH	Phenology
SI	System Instalment
SO	Soil Condition
SS	Soil Solution

1 GENERAL INFORMATION

1.1 Background

Forest Focus (Regulation (EC) No 2152/2003[1]) is a Community scheme for harmonised, broad-based, comprehensive and long-term monitoring of European forest ecosystems. It concentrates in particular on protecting forests against air pollution and fire. To supplement the monitoring system, Forest Focus stipulates the development of new instruments relating to soil monitoring, carbon sequestration, biodiversity, climate change and protective functions of forests.

Under this scheme the monitoring of air pollution effects on forests is carried out by participating countries on the basis of the systematic network of observation points (Level I) and of the network of observation plots for intensive and continuous monitoring (Level II). These monitoring activities under Forest Focus continue from the network and plots established and implemented under Council Regulation (EEC) No 3528/86[2] and Regulations (EEC) No 1696/87[3] and (EC) No 1091/94[4].

The monitoring programme of air pollution effects is linked to the *International Cooperative Programme on Assessment and Monitoring of Air Pollution Effects on Forest* (ICP Forests). ICP Forests reports to the working Group on Effects of the *Convention of the Long-Range Trans-boundary Air Pollution* (CLRTAP) of the *United Nations Economic Commission for Europe* (UN-ECE).

Forest Focus Article 15(1) stipulates that the Member States shall annually, through the designated authorities and agencies, forward to the Commission geo-referenced data gathered under the scheme, together with a report on them. For managing the data the European Commission Joint Research Centre (JRC) has implemented a Forest Focus Monitoring Database System. The system was developed and realized under contract by a Consortium, coordinated by I-MAGE Consult with Nouvelles Solutions Informatiques s.a. (NSI) as consortium partner and the Bundesforschungsanstalt für Forst- und Holzwirtschaft (BFH) as sub-contractor.

The designated authorities and agencies, the National Focal Centres, submitted annually to the JRC their observations made on Level II plots. Data are submitted via a Web-Module specifically designed for the task as part of the Forest Focus Monitoring Database System. The data are then validated in a process of three stages of checks of various aspects of the information submitted before entering the Forest Focus Monitoring Database (FFMDb).

---

[1] OJ L 324, 11.12.2003, p. 1-8
[2] OJ L 326, 21.11.1986, p. 2
[3] OJ L 161, 22.06.1987, p.1 - 22
[4] OJ L 125, 18.05.1994, p.1 - 44

1.2 Data Flow

An overview over the generic flow of data within the FFMDb System, referred to in subsequent chapters as the system, and the various stages of data processing is presented in form of a schematized standard data flow in Figure 1.

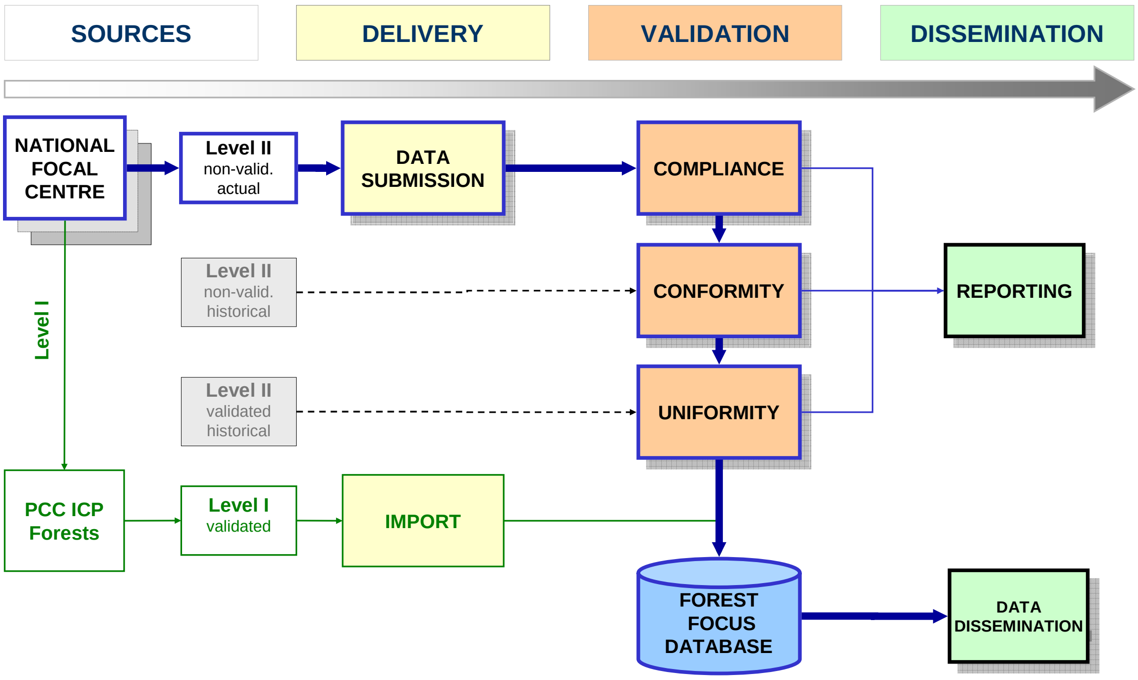


Figure 1: Schematized Standard Data Flow

Details on the various stages in the data flow are given in the sections hereafter.

1.2.1 Data Sources

Data are collected at the Level I (systematic) and Level II (intensive) monitoring plots by EU Member States and countries participating in the common monitoring scheme through bodies designated by the responsible national institutions. The data collected are forwarded by the designated authorities and agencies (National Focal Centres, NFCs) to the European Commission on an annual basis.

Data from Level I plots are managed and validated under the responsibility of the Programme Coordinating Centre (PCC) of ICP Forests. The validated data are provided by the PCC to THE JRC once per year and are integrated into the system database. Data from Level II monitoring plots are provided by NFCs directly to the JRC and validated under the responsibility of the JRC. For both monitoring surveys only validated data enter the FFMDb.

1.2.2 Data Submission

Submitting data from monitoring surveys by the NFCs to the JRC is scheduled on an annual basis. However, some surveys are not performed annually and only submitted at more infrequent intervals. Data for a given monitoring campaign should be submitted to the JRC by December of the year following the monitoring activity. For example, data from 2005 would have to be transmitted by the end of December 2006.

In line with Article 15(1) of Forest Focus the data sent by the NFCs to the JRC should be transmitted by means of computer telecommunications and/or electronic technology. For this purpose the JRC has implemented a Web-based service for electronic data transmission, the Data Submission Module of the system (DSM). The Web-application replaces the previously exercised system of preparing data on a physical storage media, e.g. CD, diskette, etc. and posting the media.

1.2.3 Data Validation

The first group of tests to be performed after data submission concerns the adherence of the data to the data format specifications stipulated in the *Technical Specifications* issues by the JRC for each monitoring year (Compliance Check). The check is performed on-line and a report on the results is generated when testing the data. The report allows NFCs to verify the adherence of the format of their data according to the specifications and to correct the data before submitting the forms.

Data that pass the Compliance Check are subjected to an evaluation of Conformity. Those tests concern the content of the data provided as opposed to the Compliance Check, which reported on formal aspects. The Conformity Check stage is followed by tests of data Uniformity. The tests are intended to establish the suitability of the data for further temporal and spatial analyses. Conformity and Uniformity Checks are performed off-line using the Service Database, because some of the tests require relatively intense processing and direct access to the FFMDb.

1.2.4 Dissemination

Level II data serves to provide information to the research and development component of the monitoring programme. The data are intended to support dynamic modelling and detailed evaluations to improve the understanding of the relationships between forest condition and environmental factors at the ecosystem level. The data can further be used in feasibility studies, which will provide fundamental information for the possible extension of the measurement of certain parameters collected at the systematic Level I plots.

To fulfil its purpose the validated Level I and Level II data from all surveys and monitoring years can be made accessible to third parties for further analysis. Data can be disseminated by providing access to the FFMDb through a web-application for downloading the relevant parts of the database in form of an XML file. Access is restricted to authorized users, who can download part or all of the validated data.

Data are available from the database to users in two forms:

- data with the spatial co-ordinates provided by the NFCs;
- data with degraded spatial co-ordinates.

The degree of degrading co-ordinates is under discussion and has not yet been set. At present data are only available to NFCs and NFCs can only access their own Level I and Level II data.

1.3 Reporting

The objective of the reporting task is to provide a comprehensive account on the data provided for a given monitoring year in form of standardized documents. The main documents produced are the *Data Submission Reports* and the *Technical Reports*. Both reports are prepared on an annual basis.

- The *Data Submission Report* presents an account of submission details and results from the Compliance Checks. The report is published in mid-March for the submission period of the previous year.
- The *Technical Report* contains results and findings from all validation checks applied to data of a given monitoring year. The reports also include the main elements of the Compliance Check as presented in the *Data Submission Report*. Results of the Conformity and Uniformity Checks are compiled separately for each NFC. A comparative summary of the results obtained from the checks is then presented. Results from a given reporting year are also contrasted with those from previous years. This comparison contains graphical and tabulated results and is accompanied by an explanation in form of describing text. Any specific areas of concern are mentioned explicitly in the text. Where appropriate, measures for improving the data submission and their compliancy are proposed.
- The *Technical Reports* are accompanied by *Executive Summary Reports*. The *Executive Summary Reports* summarize the main findings and items in a language and presentation that is targeted at a broader audience that does not have specific technical expertise.

2 DATA VALIDATION PROCESS

Data validation of data submitted by NFCs is the central task of data processing. Its purpose is to ensure that the information stored in the system can be used for an assessment of the state of a parameter sampled and in the evaluation of temporal and spatial trends between plots. It should also allow the integration of the data with other data sources in more extensive thematic analyses.

The validation of the data is achieved by subjecting the data to various test routines. The process includes, but is not limited to, verifying data formats and units used, plausibility checks and assessment of continuity of measurements. The routines are applied in succession with increasing degree of complexity of the checks performed. A graphical overview of the validation tests is given in Figure 2.

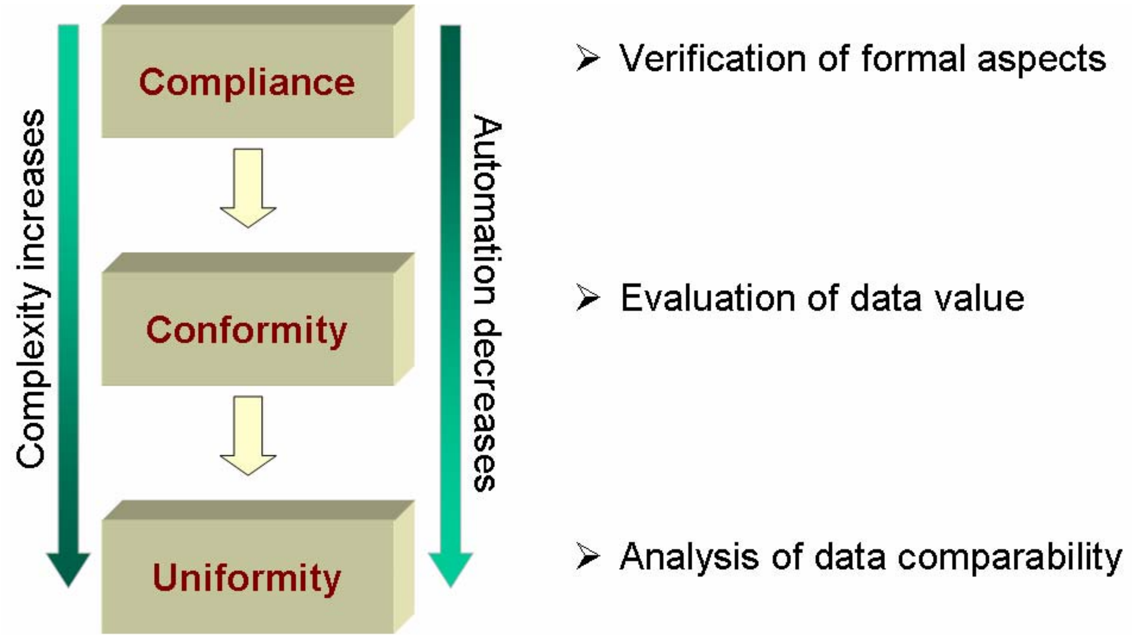


Figure 2: Sequential Arrangement of Data Validation Tests

Details on the tests applied at the various stages of data validation are presented in the following section.

2.1 Validation Checks

Data are validated based on the principle that it is not possible to identify the correctness of data, but rather that it may be possible to identify the probability that data represent valid measurements. The degree of probability is expressed by grading data by severity codes from 0 to 100 using a sequential procedure, which assesses various characteristics and applies increasingly involved checks. The value attributed during validation represents a deviation from the expected value or range of values.

Codes below 50 generate warnings and are given in cases of non-standard situations, e.g. when an optional form is not submitted or when a line contains a comment. Warnings are reminders for the NFCs to re-examine their data and do not prevent the data from being further processed, once the values are confirmed by NFCs. For severity codes exceeding 50 the result of a test is an error. Surveys containing errors cannot be further processed or loaded into the database, and the NFC will have to submit new values.

2.1.1 Compliance Check

The tests applied as part of the Compliance Check verify if the data in the submitted files of a survey comply with the specifications of the fixed formats ASCII files as stipulated in the JRC *Technical Specifications* documents. The documents are issued for each monitoring year. During compliance only syntactic checks are applied. The tests performed for data compliance are summarized in Table 1.

Any deviation from the defined format will lead to a warning message and, in case of significant deviations, an error. Also validated by the Compliance Check is whether the symbolic values used for conditions are defined, e.g. the linked dictionary entries in case of categorical parameters (codes). If a file or data value fails a test applied for Compliance, i.e. an error condition could not be resolved, the survey cannot be further processed.

Table 1: Checks Applied for Data Compliance

CODE	MESSAGE	SEVERITY
MISSING_MAN_FORM	Some mandatory form is not present: %FORM_NAME%. The corresponding file should have this extension: %ENTENSION NAME	50
MISSING_OPT_FORM	WARNING: Some optional form is not present: %FORM_NAME%. The corresponding file should have this extension: %ENTENSION NAME	10
PLOT_NOT_IN_REDUCED_PLOT_FILE	The plot %PLOTNUMBER% is not in the reduced plot file	55
NO_VALUE_ALLOWED	There is a character: %CHAR% in a column that should not contain any data : %COLUMN_NUMBER%	60
CODE_NOT_IN_LIST	A coded parameter has a value %PARAM_VALUE% not in the list %DICTIONARY_NAME%	65
NOT_A_VALID_DATE	Parameter %PARAM_CODE% at position %START% to %END% : %PARAM_VALUE% is not a valid date. Format must be %FORMAT%	70
NOT_A_VALID_NUMBER	Parameter %PARAM_CODE% at position %START% to %END% : %PARAM_VALUE% is not a valid number.	75
VALUE TOO LONG*	Parameter %PARAM_CODE% at position %START% to %END% : %PARAM_VALUE% is not a valid number.	80
TOO_MUCH_DECIMAL*	Parameter %PARAM_CODE% at position %START% to %END% : %PARAM_VALUE% has too many decimals. Format must be %FORMAT%. The value will be interpreted as %ROUNDED_VALUE% in further processing	20
TOO_FEW_FORMS	Error, you must submit all forms, DARQ and other documents of a survey in one submission. Your submission contains only one form and a survey must contain at least two forms	90
INVALID_CHAR	Line contains invalid character	60
CODE_NOT_IN_LIST	A coded parameter has a value not in the corresponding dictionary	80
CODE_COUNTRY_NOT_CORRESPONDING	The country code doesn't correspond to the current country	80
NOT_A_VALID_COORDINATE	Not a valid coordinate	40
BLANK_LINE	Blank line	05
CMNT_LINE	Line was interpreted as a comment	05

* The VALUE_TOO_LONG and TOO_MUCH_DECIMAL errors should not occur, although the condition is still tested.

2.1.2 Conformity Checks

The Conformity Check comprises a number of tests that are applied after the submitted data have been subjected to the Compliance Check. The tests are not performed in the temporary storage area of the Web-server, but in the staging area of the database.

The principle of the Conformity Check is to evaluate the probability that a data value is an actual observation. The condition is evaluated with the aid of single parameter range tests, including test of boundaries for geographic coordinates. The tests can also detect impossible values, e.g. pH = 0. Data consistency is also tested via cross-checking for the continuity of static values, e.g. individual tree species, altitude, or logical continuity of the change of variable values, e.g. tree diameter according to temporal consistency. All these tests aim at assessing plot-specific conditions. Information from other plots is not taken into account at this stage.

The various tests of the Conformity Check are grouped as follows:

- ***Range: monitoring year, single parameter tests***

  The range tests are conducted by doing simple SELECT queries on the data. All values that do not fall within a specified range will be flagged with ‘err’ or ‘warning’, respectively. Because it is possible to vary these values the minimum and maximum parameters used during the checks are stored directly in the database. They are documented and reported together with the check results. When an NFC verifies the correctness of a value flagged during the range test this condition can be stored in the database by marking it as “extreme value”.

- ***Conditional: Monitoring year, multiple parameter tests***

  Some tests check the consistency of a parameter with values of other parameters or fields reported. In some cases these rules imply specific conditions for the application of the check. For example, Check # 138 has to be applied only on those values submitted for mineral layers of the horizons M01, M12, M24, or M48. Other checks are related to parameters in the same table as the field that is checked (e.g. Check # 155) or in other tables (e.g. Check # 137). All the multiple parameter checks are performed using “SELECT …. WHERE …” queries. These checks, which are performed on more than one table, include a JOIN statement.

- ***Consistent: Multiple years, single parameter, temporal test***

  Temporal consistency is checked by comparing the values of the monitoring year with values which were submitted for the same parameter and plot in former years. The temporal consistency checks aim at assessing the continuity of those parameters which should not change over time, like the site co-ordinates. Any deviation from the previously validated values will result in an ‘error’. For values that can vary over time, but which are expected to change in a certain direction or by a particular amount, a ‘warning’ is given. An example for this type of parameters is growth values.

A list of the parameters used for all single and multiple tests for Conformity applied can be found in Annex 1.

The results of the tests are at times extensive lists of flagged values, which indicate either an error for values indicating potentially unusual conditions or a warning for values outside a pre-set range. All flagged values are listed and described with an explanatory legend in a report, which is transmitted to NFCs to allow verifying the situation.

By design the checking routines could detect unlikely values for a defined data range (approximately at the 95% level), which was mostly derived from the Level II legacy data validated by the Forest Intensive Monitoring Coordinating Institute (FIMCI) or from expert knowledge. It does not necessarily mean that a value generating a message is actually wrong. The NFCs are asked to pay attention to those values and state if the values are correct but outliers, or if the data need corrections and have to be re-submitted.

2.1.3 Uniformity Checks

The Uniformity Check consists of an interpretation of temporal and spatial development of parameters using data from all plots. Contrary to Conformity data Uniformity is verified by comparative tests using more than the information from a single plot. They are intended to identify inconsistencies in the data which could not be found during any of the previous checks. Uniformity tests are more qualitative and require the interpretation of the results by an expert in the field. The interpretation includes a comparison with external data as far as such information is available in a suitable form.

The check includes an automatic procedure for generating maps for various key parameters monitored. In general, the map depicts the status of a given parameter for the monitoring year. Where appropriate a status map is supplemented by a map showing changes over a previous monitoring year. While the compilation of the maps is relatively straightforward for continuous surveys the process is less apparent for surveys with longer monitoring intervals, such as Growth or Soil Condition. The main obstacle for non-annual surveys and data collected for comparing conditions at one plot with those from other plots or analysing changes over time is the lack of data for any given monitoring year. This is most extreme for Soil Condition with a repeat cycle of 10 years. On average one would expect data for 10% of all plots for a monitoring year, which is largely insufficient for a comparative analysis. Therefore, the tests for data of non-annual surveys use data from one or several previous surveys, which are not from an immediately preceding year.

2.2 Process Control

Data are processed by NFCs until they are submitted using the Data Submission Module (DSM). There are some principal differences in managing data before and after data submission. Before data are submitted they can be tested, deleted and re-loaded into an intermediate storage area as often as considered necessary by an NFC. Once submitted the data are no longer accessible to an NFC and cannot be modified or deleted. However, new versions can be submitted and take precedence over previous versions

2.2.1 Process Control before Data Submission

A graphical presentation of the process control for data submission is given in Figure 3.

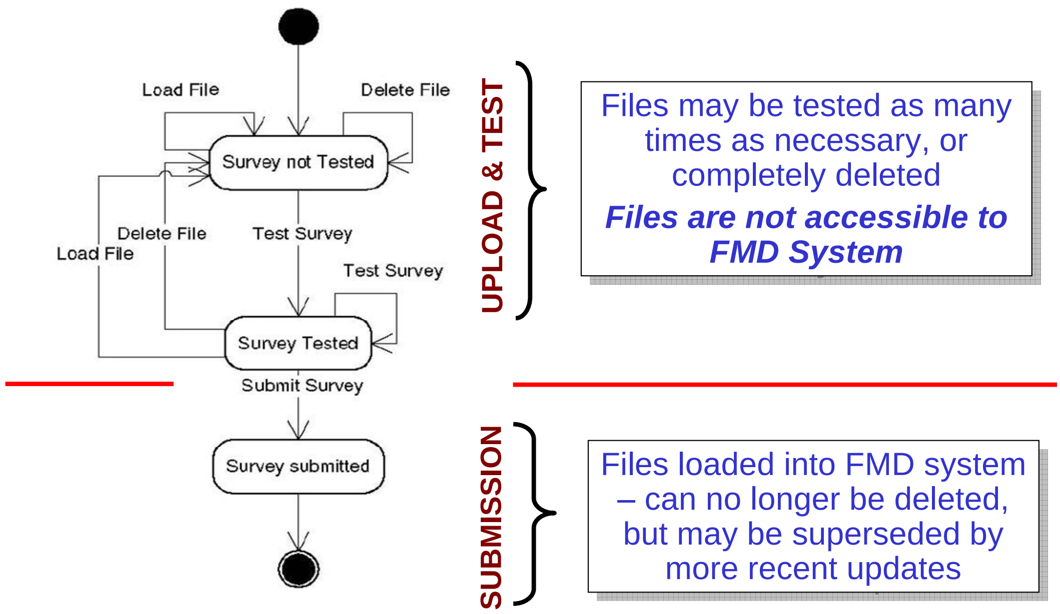


Figure 3: Process Control

For a given monitoring year the forms comprising a survey are selected and then uploaded into the intermediate storage area on the Web server. Once all forms comprising a survey are uploaded the survey is tested. Forms generating errors can be deleted, data corrected and reloaded by the NFC without any restriction. Once a survey is complete the data are tested for compliance. Testing a survey can be performed as required and the last results are stored in form of a report, which is available to the submitting NFC in PDF format. Once a survey has been tested it can be submitted. It should be noted that a survey can be submitted containing warnings, but also errors. However, surveys containing errors cannot be processed.

2.2.2 Process Control after Data Submission

When a survey has been submitted, the files are passed on to a different storage location and are no longer available to the user for modifications. The user can still view the results of the Compliance Check and a submission summary, but the data from surveys submitted can no longer be deleted from the system. This data management policy has been adapted to allow generating a history of data submissions, which not only contains the dates of previous submissions, but also the data transferred.

In case a survey is submitted more than once the following rules apply:

1. Only one version of data will ever be processed and incorporated in the database.
2. When two survey types for the same year are submitted without errors, the more recent one will be processed. The NFC is encouraged to add an explanatory note to the files of the survey newly submitted.
3. For new submission made after the end of the submission period the new data can only be accepted and processed, if
    a. processing of a corresponding valid submission has not already been started or
    b. new data is requested due to inconsistencies in the format or value submitted, which were detected during subsequent processing of the data.

In all cases concerning data submission copies of the files are kept in the system for reasons of transparency.

Subsequent to the management of data in the data submission module a number of tasks are launched to transfer the values to the FFMDb for further processing:

- The files submitted via the JRC Internet server are copied to the system of the Service Provider. All submitted files, forms, Data DARs and other files must be loaded in the database. They will be kept in their original form as BLOB fields of the database, thus retaining the original file formats.
- The forms are loaded in corresponding database tables (staging area) for further processing. At the same time, the results from the Compliance Check performed during data submission are stored in the database in the same form as other test results. In this way, they will be available for reporting by querying the database.
- The data are tested for Conformity and Uniformity. Results from these tests are also recorded in the database.
- Some situations having generated a message can be marked as extreme events after confirmation by the NFC.
- Finally those data, which have passed the validation process, are transferred to the FFMDb.

2.2.3 Interpretation of Warnings and Errors

A sliding scale of warning and error messages was developed to label the results of the validation tests, because it is frequently not possible to identify without doubt that data are incorrect. The result of each validation test carries a message and associated severity code. The status “error” is only given when the code exceeds 50 and there is a clearly impossible situation. Some modification of the data will be required before further processing can take place. Warnings, however, simply draw attention to unusual events. In this case the NFC is asked to check each flagged value and either confirm its correctness or (if the value was erroneous after all) resubmit a corrected survey.

At the compliance stage, errors are fairly simple to detect and interpret. They are divided into three main types:

- Errors in the data submission procedure itself (missing mandatory form, not enough forms to complete the survey).
- Known "impossible" values within the files themselves, such as invalid dates, invalid characters and codes outside the given lists.
- Integrity checks within the survey to check that plots within the data file are also mentioned within the reduced plot file.

Warnings draw attention to missing optional forms (in case the NFC intended to submit the data but forgot), blank lines (in case this should have contained data) and comment lines (to confirm that the line should be there and is a genuine comment).

At this stage no consideration is given to the plausibility of a given value, only whether it fits the stated data formats.

At the conformity stage the actual data values are checked. As before, an error message confirms that something is wrong; however in this case it is not necessarily possible to ascertain precisely where the error lies. Most of these tests yield warning messages rather than errors as it becomes more difficult to detect values that are clearly erroneous.

Errors are divided into three main types according to the type of test applied:

- *Single parameter range tests* (e.g. values must be between 0 and 100 for percentage values).
- *Multiple parameter range tests* within a given survey (e.g. start date must be before end date).
- *Temporal consistency tests* (e.g. invariable parameters such as coordinates, altitude must not change).

Warnings are similarly divided. The single parameter range checks flag any data value that is outside an expected range for that parameter. Ranges were mostly derived from the legacy data set and identify any value outside an approximate 95% level. Multiple parameter range checks note anomalous combinations of values, and the temporal consistency tests check for unusual increases/decreases in parameters (e.g. diameter values should increase over time, but not by more than a certain amount).

The validation system therefore identifies impossible values and also many unusual ones. However, there are limitations:

- The tests can detect an anomalous difference between two values but cannot compute which of them is erroneous.

- Submitted values that do not conform to the protocols (e.g. using different units) may not be detected unless the different units lead to data values outside the expected range. Similarly, elements submitted in the wrong order but within correct column widths will only generate errors if the normal ranges of the elements are different from each other.
- The range checks cannot pick up every implausible value. An average daily temperature of 30˚C in Spain in July will be flagged with a warning as an extreme event but 20˚C in Finland in January will not, because at present there are no seasonal/geographical constraints built into the system. To do so would introduce a significantly increased level of complexity into the tests; which may be out of proportion to the extra number of anomalous values actually detected.

The more complex the checks, the less clear-cut will be the results provided. The validation checks have to strike a balance between being too strict and thus incorrectly highlighting valid data or too broad to identify genuinely erroneous values.

2.3 Validation Reports and Feedback from NFCs

A report in PDF format on the status of the data Compliance is performed instantly when testing the data and available on-line. The tests applied for Conformity and Uniformity are more complex and involve interrogating data stored in the database. They are performed off-line in the staging area. For the results of the Conformity and Uniformity Checks NFCs receive by e-mail an automatically generated detailed processing status report containing any warnings and errors raised. The communication to NFCs also contains a request for data correction(s) and/or confirmation(s).

In response to the reports NFCs have the opportunity to react in three different ways:

- Where extreme values are confirmed by the NFCs, corresponding registry lines will be flagged as extreme event and the data is carried forward;
- In case of errors, the NFC has to correct the errors and re-submit the whole survey through the data submission module. The data then have to pass back into the workflow and pass through the complete validation process (compliance, conformity and uniformity) again;
- If no answer was provided by the NFC before the deadline and/or errors are still identified, data cannot be fully validated and the complete survey cannot be loaded into the FFMDb.

In practice the results from Conformity Checks are presented by survey in a document file and by message in form of a table. The two report summaries are sent to NFCs to check and verify the situation and subsequently send a confirmation or re-submit the surveys with corrected data.

2.4 Validation Limits

Although the validation process is quite comprehensive and the tests are fairly complex the data stored in the FFMDb and made available for dissemination cannot necessarily be declared correct. According to the principle of the checks data are not tested for being correct, but for the probability that a value is outside of what could be expected as admissible. The limits of range tests are in most cases taken from the Level II legacy data and expert knowledge. For a given parameter the ranges are set globally and are not specific for countries or bio-geographic regions. This geographically unspecific method is low on maintenance overhead and straight forward to implement, but results in a higher probability of the oversight of outliers in countries with intermediate conditions. Whenever a parameter is similar in the range of observations to another parameter, e.g. for chemical elements, entering the parameter in the wrong column or even reporting the wrong parameter will also not be detected by the tests.

When data are recorded correctly in the forms there may still be differences in measurement methods between NFCs or laboratories. When differences in measurement methods lead to variations in the data reported those methods should be stored with the data. This option is rarely available in the forms and the information is easily lost. In the absence of recording meta-data it is recommended to make use of the option of the system to include in the submission at least a document stating the methods and instruments used for collecting data at the plots as part of the DAR.

3 SUBMISSION OF 2003 LEVEL II MONITORING DATA

This *Technical Report* presents the results obtained from all processing stages (data submission, validation checks – Compliance, Conformity and Uniformity) for submitted data referring to the monitoring year 2003. Data and comments received by 04.05.2007 are processed and included in this report. Data or comments received after this date are generally not part of this report.

The report includes the main elements of the Compliance Check as presented in the *2003 Data Submission Report* (European Commission, 2006). In addition, the report contains more detailed results from the Conformity and Uniformity Checks compiled for each NFC in the Annex. A comparative summary of the results obtained from the checks is also provided.

3.1 Data Submission Periods

The standard procedure of data processing is for NFCs to submit data using the Web-based DSM during the period specified for a given monitoring year. Data are then passed on to the validation process and once fully validated are integrated into the FFMDb. When data do not pass one or more of the tests they should be corrected and re-submitted by the NFC. For reasons of organizing the processing chain the submission of data is restricted to specific periods.

During the data submission period at the end of a year following a monitoring year any survey can be submitted. When submitting surveys the Compliance of the data is tested according to specified file and data formats. Only data having been tested OK should be submitted. However, the module does not necessarily prevent erroneous data values to be submitted. To allow NFCs to correct those data the Web-site can be opened for a post-submission period for corrected data for surveys previously submitted.

Data failing any of the checks for Conformity and Uniformity can also be corrected and then re-submitted. For this purpose the Web-site is opened for a specific period only. Any data re-submitted, also data having previously passed the Compliance Check, have to pass once again the checks in the order of (1) Compliance, (2) Conformity and (3) Uniformity.

For the submission of data of Level II plots for 2003 (also 2002 and 2004) EU-Member States were invited to submit their data in a letter from DG ENV from 01.12.2005 Ref. No. ENV B3 ES/RF/mm D05 25135). Non-EU states participating in the scheme were invited to submit their data using the same procedure in a letter from 18.01.2006 (Ref. No. H07-LMNH/RH-D(06)1103).

For 2003 data the standard submission delays of one year after the end of the monitoring period did not apply and data were submitted by NFCs in December 2005 together with data from 2002 and 2004.

The sequence of data submissions of 2003 data for validation is graphically presented in Figure 4.

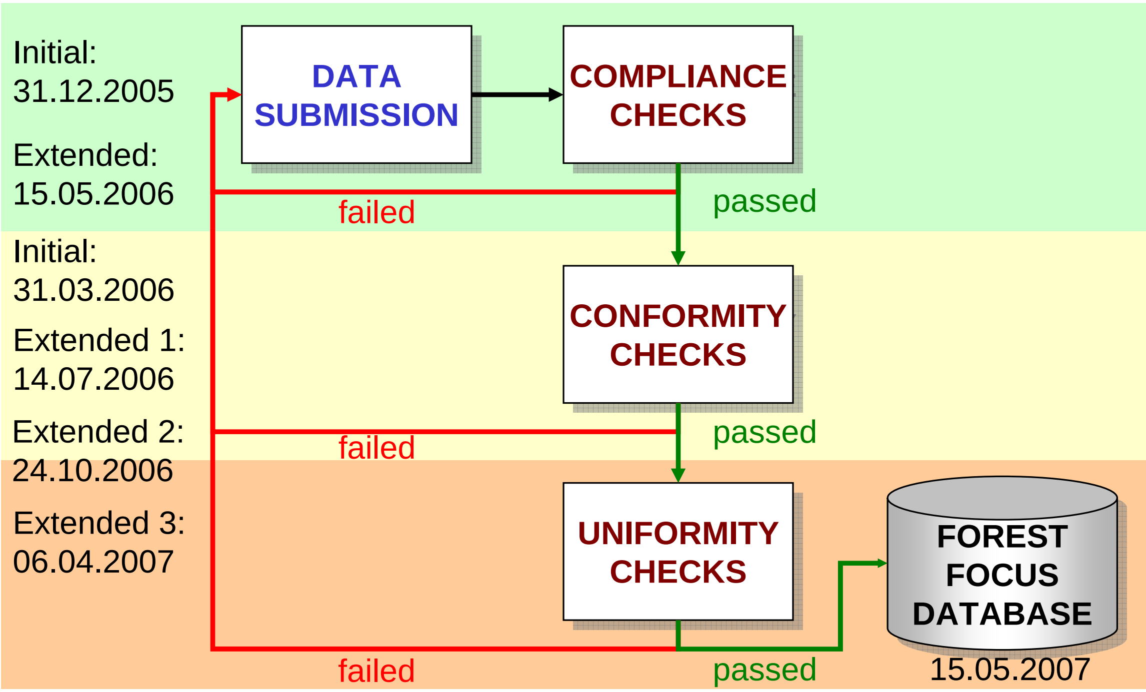


Figure 4: Data Validation Schedule for 2002, 2003 and 2004 Data

The amount of data to be submitted, i.e. surveys from 3 monitoring years, and the new procedures the NFCs were confronted with has led to a fair amount of uncertainty with respect to the process. One particular obstacle to overcome was the assumption that any data having passed the compliance checks could be considered validated and correct. The condition was not helped by changes in the survey forms between the reporting years. As a consequence the data format for 2003 data would not necessarily be the same for any other years submitted at the same time.

To allow NFCs to adjust to the new situation the possibility to submit 2003 data was offered during several periods. The last period for submitting or re-submitting corrected data was scheduled from 26.03.2007 to 06.04.2007. Some submitted corrected data later than the date. Those data could be included in the validation when they were received by 04.05.2007.

3.2 Survey Submissions for 2003 Monitoring Year

The DSM was initially open for the submission of 2003 data from 01.12. to 31.12.2005. The last period of re-submitting 2003 data was from 26.03. to 06.04.2007. Some NFCs asked to re-submit previously erroneous data after that date and the DSM was opened exceptionally to allow those NFCs to submit their corrections.

The final submissions of data included in the processing, on which this report is based, date from 04.05.2007. An overview of the status of data submitted by NFC by this date is given in Figure 5.

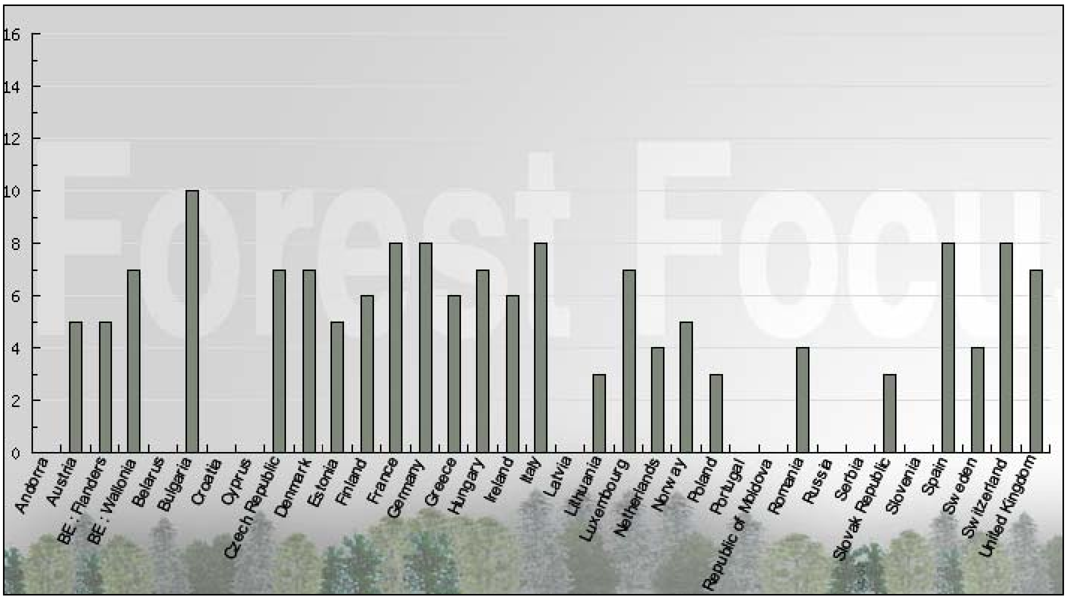


Figure 5: Number of Submitted Surveys by NFC (2003 Monitoring period. Status 04.05.2007)

At the time of the processing deadline 25 NFCs had submitted data for monitoring year 2003. Forms were submitted for 151 surveys[5]. The number of surveys is lower than for 2004 and 2005 but has increased significantly comparing to previous 2002 monitoring year. The total number of surveys submitted for Forest Focus monitoring years as received by May 2007 is as follows:

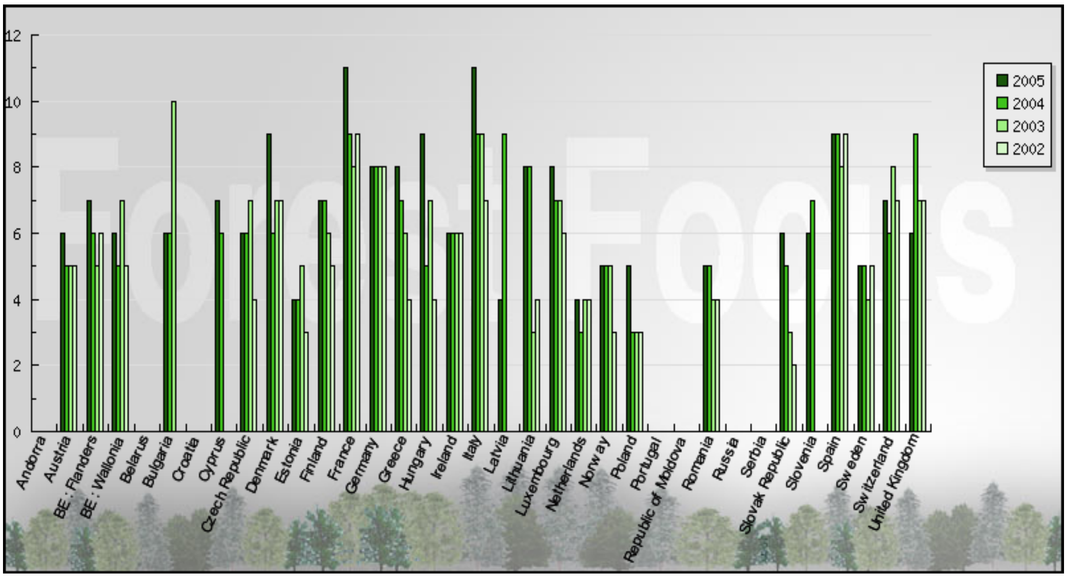
- 2002: 127 2003: 151 2004: 176 2005: 191[6]

[5] One survey previously included was removed on request from the NFC concerned.

[6] At the time of report compilation.

A graphical representation of the number of surveys tested by NFC and monitoring year is given in Figure 6.

Surveys



National Focal Centres

Figure 6: Number of Surveys submitted by NFCs under Forest Focus for Monitoring Years 2002, 2003, 2004 and 2005

Not included in the number of files submitted are any additional information added to the submission in form of DARs or free text files. The throughput of testing data could only be achieved by the automatic process installed and by making the test results available as on-line information to NFCs for consultation and evaluation.

4 VALIDATION OF 2003 LEVEL II MONITORING DATA

Because of the repetition of the submission periods the validation of 2003 Level II data was performed in two main phases. The first phase consisted of the validation following the submission of data in December 2005. The number of fully validated surveys was relatively small. It was decided to attach a second validation phase, in which all data would be processed in strictly sequential order. This second phase profited from an evaluation of the legacy data, i.e. data from monitoring periods before 2002, and validated data from the 2002 monitoring year.

4.1 Compliance Check

The Compliance Check forms an integral part of the data submission process. For the submission period of December 2005 the NFCs had for the first time the opportunity to submit data through the web-based DSM. The DSM allows the submitting authorities direct feedback on checks of data and correcting any errors before transmitting the files as submitted data. The reports are generated automatically for each survey submitted. They contain the information on the status of the survey and information for each warning or error found in the data with a comment on the nature of the problem.

The status of all surveys submitted by NFCs at the end of the final date of submission is summarized in Table 2.

For 2003 Bulgaria joined the Monitoring programme and submitted data for the first time. It was also the NFC with the largest number of submitted surveys. The number of surveys submitted by NFC for 2003 is as follows:

- Bulgaria: 10 surveys
- France, Germany, Italy, Spain, Switzerland: 8 surveys
- Czech Republic, Denmark, Hungary, Luxembourg, United Kingdom: 7 surveys
- Belgium (Flanders), Finland, Greece, Ireland: 6 surveys
- Austria, Belgium (Wallonia), Estonia, Norway: 5 surveys
- The Netherlands, Romania, Sweden: 4 surveys
- Lithuania, Poland, Slovakia: 3 surveys

Table 2: Compliance Status by Survey and NFC for Monitoring Data of 2003

Country	Survey												
	SI	CC	SO	SS	FO	GR	DP	MM	GV	PH	AQ	OZ	LF
Austria	-	W	-	O	O	-	W	W	-	-	-	-	-
BE : Flanders	-	W	-	O	W	-	O	W	-	-	-	-	-
BE : Wallonia	O	O	-	O	O	-	W	O	O	-	-	-	-
Bulgaria	O	W	W	W	W	-	W	W	O	-	W	-	W
Cyprus	-	-	-	-	-	-	-	-	-	-	-	-	-
Czech Republic	O	O	-	O	O	-	O	W	O	-	-	-	-
Denmark	O	W	-	W	W	-	W	W	-	-	-	-	O
Estonia	O	W	-	W	O	-	W	-	-	-	-	-	-
Finland	-	W	-	W	W	-	W	W	W	-	-	-	-
France	-	W	-	O	-	W	W	W	-	W	-	W	W
Germany	O	O	-	O	O	W	O	O	O	-	-	-	-
Greece	O	W	-	W	O	-	W	W	-	-	-	-	-
Hungary	-	O	-	-	O	-	W	W	O	W	-	W	-
Ireland	W	W	-	W	W	-	W	W	-	-	-	-	-
Italy	O	O	-	O	O	-	W	O	O	-	W	-	-
Latvia	-	-	-	-	-	-	-	-	-	-	-	-	-
Lithuania	-	W	-	W	-	-	W	-	-	-	-	-	-
Luxembourg	-	W	-	-	W	-	W	W	-	O	W	-	W
Netherlands	-	O	-	W	O	-	W	-	-	-	-	-	-
Norway	-	W	-	W	W	-	W	-	O	-	-	-	-
Poland	-	W	-	-	-	-	O	-	O	-	-	-	-
Portugal	-	-	-	-	-	-	-	-	-	-	-	-	-
Romania	O	W	-	-	-	-	W	-	-	W	-	-	-
Slovak Republic	-	W	-	-	-	W	W	-	-	-	-	-	-
Slovenia	-	-	-	-	-	-	-	-	-	-	-	-	-
Spain	-	O	-	O	-	W	O	O	-	O	O	W	-
Sweden	-	O	-	W	-	-	W	W	-	-	-	-	-
Switzerland	-	W	-	W	W	-	W	W	W	-	W	W	-
United Kingdom	O	W	-	O	O	-	W	W	-	-	O	-	-
TOTAL	**11**	**25**	**1**	**20**	**18**	**4**	**25**	**18**	**10**	**5**	**6**	**4**	**4**
Relative OK	**91%**	**32%**	**0%**	**45%**	**56%**	**0%**	**20%**	**22%**	**80%**	**40%**	**33%**	**0%**	**25%**
Relative OK, OK with Warning	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Status: 04.05.2007

O	= OK	W	= OK with warnings	E	= Errors detected

For the monitoring period of 2003 data were submitted for all surveys monitored although only one NFC submitted data for the Soil Condition survey. This circumstance can be explained by the long monitoring and sampling interval of 10 years for this survey. In total data were submitted for 151 surveys. Based on the number of NFCs most data were received for the surveys of Crown Condition (25), Deposition (25), Soil Solution (20), Foliage (18) and Meteorology (18).

Of all surveys submitted 59 (39%) were tested OK. Tested with warnings were 93 surveys (61%). None of the surveys generated error messages. Thus, all surveys could enter the next validation stage, which translates into 100% of surveys passing the Compliance Check.

4.2 Conformity Check

Processing 2003 surveys for Conformity started in July, 2006 and the procedure was then repeated in 2007. For each NFC the results of the check were compiled in form of an automatically generated detailed status report. The reports were transmitted to NFCs during September and October 2006. A request for correction(s) and/or confirmation(s) was included in the report and NFCs had the possibility to react until a set deadline. This procedure was repeated in 2007 when NFCs received the Conformity status reports before the DSM was opened for re-submission from 26.03. to 06.04.2007.

4.2.1 Conformity Check Results by Country

The tables presented in Annex I give a detailed view of tests applied to validate data for conformity. In Annex II the results obtained from applying the tests are presented by country. For each form the number of parameters tested is stated, the number of tests with an error or a warning and the final checking result. Surveys not tested are marked “NT”. Surveys tested without error or warning are marked as “OK”. When the tests generated an error or warning the survey is marked as “NOK”.

For each country the tabular presentation of the test results in Annex II includes the status of the survey data after communication with the NFC. Only surveys where all tested forms were free of warnings and errors can be forwarded to be tested for Uniformity. Warnings needed a clarification from the respective NFC and errors correcting by re-submitting forms.

4.2.2 Conformity Check Review

An overview on the number of tests performed for Conformity on the data which have passed the Compliance Check and the respective number of tests with errors or warnings is given in Table 3.

Table 3: Summary Conformity Test for all Countries, year 2003

Country	Number of Conformity Tests	Number of Tests with Messages
Austria	103	20
Belgium	175	37
Bulgaria	137	15
Czech Republic	137	22
Denmark	92	21
Estonia	66	8
Finland	162	41
France	132	42
Germany	194	90
Greece	91	9
Hungary	132	11
Ireland	112	13
Italy	154	24
Lithuania	40	1
Luxembourg	142	12
Netherlands	91	26
Norway	63	14
Poland	54	22
Romania	37	1
Slovak Republic	56	1
Spain	106	17
Sweden	75	21
Switzerland	121	32
United Kingdom	118	35
Total	**2590**	**535**

In total 2590 tests were performed on the surveys. The surveys passed 80% of the tests, which improves over processing 2002 data, where 75% of the surveys passed the tests.

With the aid of the Conformity Check a large number of potential errors, outliers or specific codings were identified. Some errors or warnings were detected in one or more surveys from all NFCs. The results of tests with warnings or errors were communicated to the NFCs. NFCs were asked to verify the situations highlighted and to give a statement for all warnings (e.g. confirmation of extreme values). Whenever error messages were generated a re-submission of corrected values is requested. The only exception is that new trees on a plot, which automatically trigger an error, can also be confirmed by the respective NFC without a re-submission.

Similarly to the previous 2002 monitoring year, no Conformity Check could be performed due to missing data for the following NFCs which have submitted data in former years from Level II plots: Croatia, Latvia and Portugal.

As for the 2002 monitoring year the 2003 data gave a comparatively high number of messages in the data from the Meteorological survey. However, re-submissions of data coded according to the recommendations given for recording missing values reduced the total number of messages after the reprocessing of the 2003 data significantly.

Again the proportion of messages triggered by range tests, especially in the Meteorological survey, was much higher (94%) than messages triggered by tests detecting temporal inconsistencies. The results are graphically presented in see Figure 7.

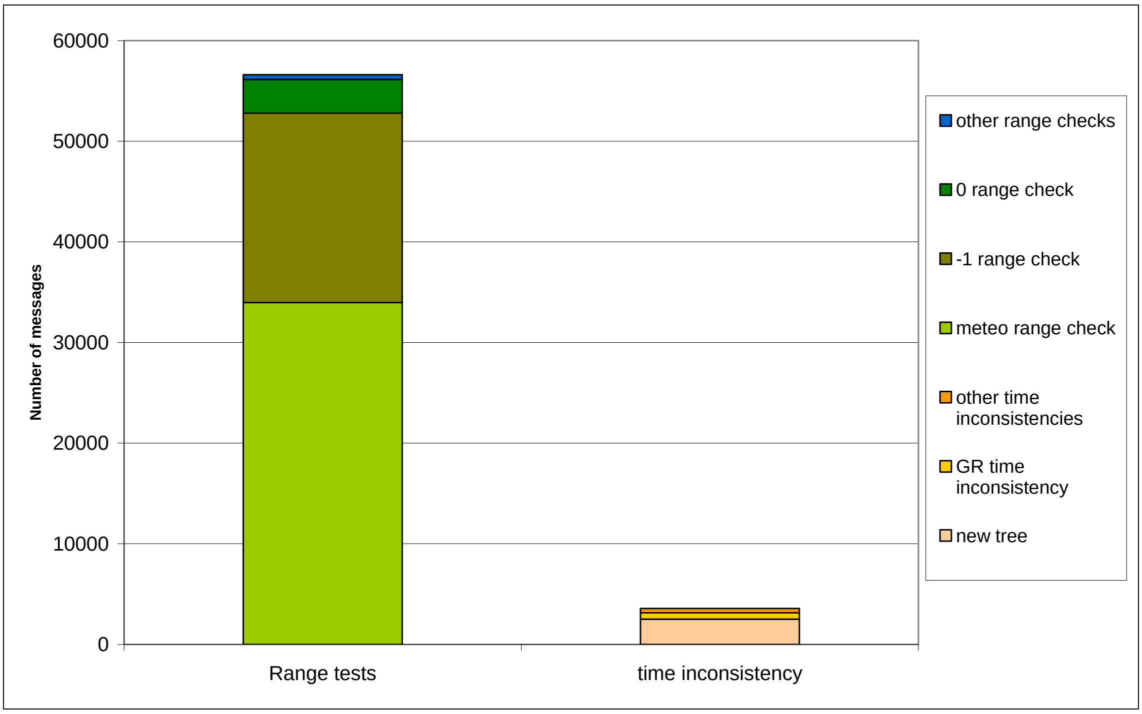


Figure 7: Number of Messages Generated During Check of Data Conformity

Besides the numerous warnings for values outside the ranges in the Meteorological surveys the most common warnings and errors were caused by the following conditions:

- changes in static parameters, e.g. plot coordinates, tree species;
- discontinuity of typical changes for variable parameters, e.g. growth;
- the treatment of missing values and values below the detection/quantification limits.

Most of the detected errors in changes of constant parameter were due to the occurrence of new trees on the plots (70%), individual trees that changed species type over time (4.5%), and changes in plot coordinates or altitudes (7.1%). A summary of the number of messages by group is given in Figure 8.

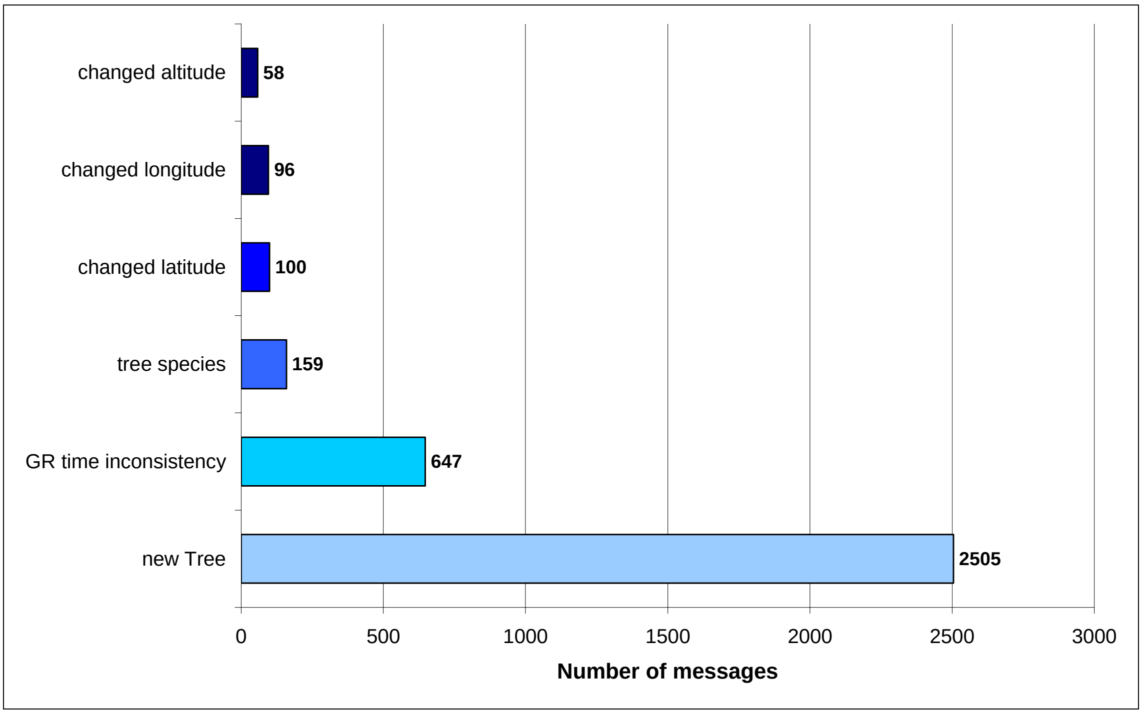


Figure 8: Number of Messages Generated in the Temporal Consistency Tests

Reasons for generating messages in the analysis of temporal consistency were that a plot or a tree was assessed the first time, the location of a plot has changed, or the previous submitted value was incorrect or less accurately measured. Furthermore, where data were identical to data submitted for 2002 the same messages were generated for the 2003 data with respect to the legacy data in cases where 2002 data could not be fully validated. This circumstance occurs, because data are only validated with respect to data found valid. Data from 2002, which were not found valid or were not verified and declared correct by the NFCs were not added to the FFMDb. Consequently, if the same data were submitted again in 2003, as in the case of numerous inconsistent tree numbers, the tests have triggered again an error for an unknown tree.

Warnings concerning continuity of changes with an abnormal progression were only found in the Growth Assessment data (647 times). The messages were generated by conditions of for instance “shrinking” trees, meaning the diameter or the height is smaller than in the previous measurement. Mostly, the data were corrected and re-submitted by NFCs or confirmed as correct. In some cases, an unusual time interval between two measurements, incorrect measuring technique, or stem breaks could also explain these warnings. Also measurements of tree height have *per se* a high variance, especially in dense stands. In addition, natural variability of the diameter of trees in low productive forests in combination with low water availability in the growing season could explain a very low increase of the diameter or even a decrease between two measurements. Some cases were found where growth reported between two measuring intervals was higher than the expected increase for Europe not regarding tree species or stand site conditions.

An overview over the messages generated by the single parameter tests is given in Figure 9.

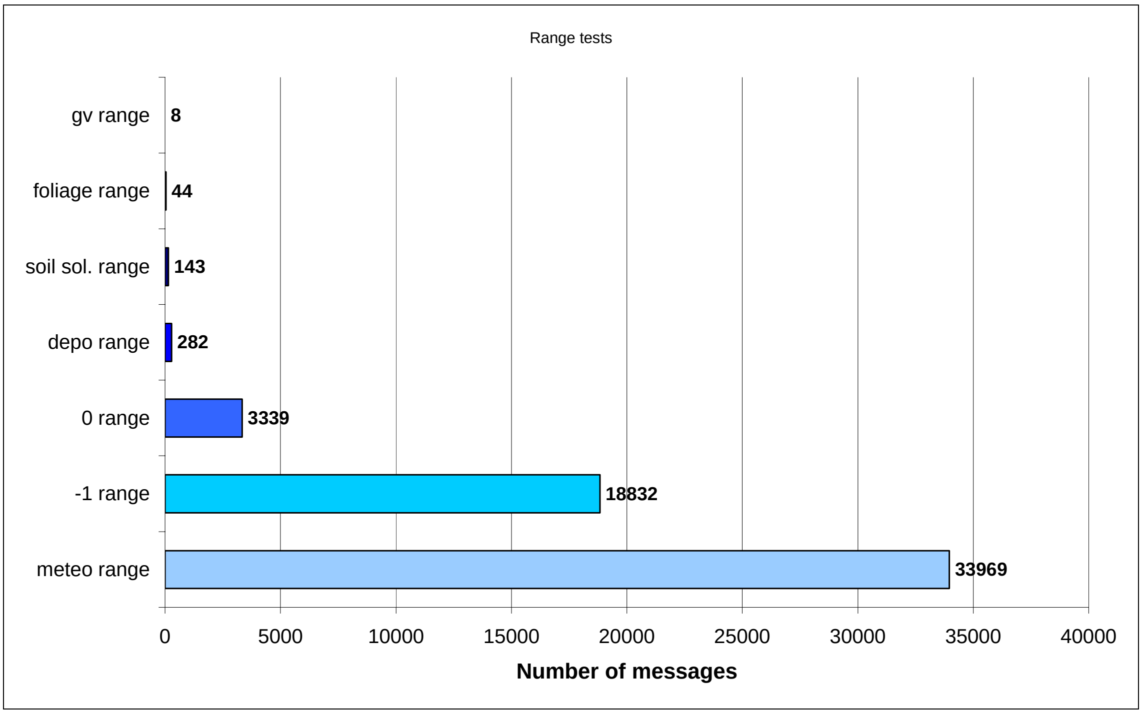


Figure 9: Number of Messages Generated in Single Parameter Tests

Most conditions which triggered warnings during the tests for single parameters were caused by the range tests. 60% of the warnings in the single parameter range tests were due to values out of the range in the Meteorology survey, one third due to the use of “-1”, and 6% due to the use of 0 values used in places of ambiguity. Only 0.8 % of all warnings in the range tests are belonging to other surveys like Deposition, Soil Solution, and Foliage or Ground Vegetation.

One reason for high number of messages in the Meteorology survey is the comparatively large amount of data and, therefore, a higher probability of identifying outliers. In addition, the periods of severe heat and drought during summer 2003 in many parts of Europe have caused air and soil temperature values to climb out of the ranges in numerous cases.

The ranges for all measurements were set to be the same for all countries and not specific by region or by plot. That means, especially for the Meteorology survey, that e.g. countries with an intermediate climate tend to receive fewer warnings with the risk in these cases that some outliers may be overlooked. Yet, the range values cannot be set too large or values reported in different units, (e.g. dm instead of cm for tree diameter) or parameter values submitted in the wrong column would not be highlighted during the tests.

The high number of warnings due to the use of “-1” or “0” values are almost exclusively located in the Soil Solution and Deposition surveys. The “-1” values were in a lot of cases confirmed by the NFCs as a code signifying a measurement below the detection limit of instrument used. The value “0” was used signifying several diverse conditions, such as to code the absence of a measurement, for values outside the field format limit (rounded to “0”) and measurement outside the detection / quantification limit. Due to the ambiguous nature of the “0” value for some parameters the checking routines are set to always generate a warning when a value of “0” is found for those parameters. The situation should be verified and defined by the NFC. But for some NFCs the values were only stated as correct without an explanation of the meaning of the zero.

4.2.3 Conformity Status of 2003 Data

The status of the surveys after the Conformity Check is summarized in Table 4. The table presents for each survey, for each country participating and for the three years (2001/2002/2003) the conformity status for the compliant submitted surveys. Tests on temporal stability and plausibility of change of parameters generally use validated data from previous survey(s), unless the survey data have been submitted for the first time. In order to provide some visual guidance to the data used in the analysis of temporal stability and trends the table also indicates, whether the validation could use data submitted from the previous survey or had to use data from an older survey.

Some of the tests for Conformity include data from the legacy database. The legacy data of the FFMDb originate from a delivery made by FIMCI to DG AGRI in August, 2003 and covers monitoring years up to 2001. For all legacy data it is assumed that the surveys are fully validated according to the procedures applied at the time. Legacy data for 2001 were evaluated according to the tests of data Conformity and Uniformity to assess their influence on data from subsequent monitoring periods (Hiederer *et al.*, 2007). This situation comes about when data for 2002 were submitted but failed the validation, i.e. were not transferred to the FFMDb, so data from a legacy survey were used to validate the new submissions.

Table 4: Data Conformity Status 2001, 2002 and 2003 by NFC and Survey

Year 200-	SI			CC			SO			SS			FO			GR			DP		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
AT				✓	✓	✓				✓	×	×	✓	×	×				✓	×	×
BE		×	✓	✓	✓	✓				✓	×	✓	✓		×				✓	✓	✓
BG			✓			✓			✓			✓			✓						×
CH		✓		✓	✓	✓				✓	✓	✓	✓		✓				✓	✓	✓
CY																					
CZ			✓	✓	✓	×				✓	×	×	✓		×				✓	✓	×
DE		×	✓	✓	×	×				✓	×	×	✓	×	×	✓	×	×	✓	×	×
DK		✓	✓	✓	✓	✓				✓	✓	✓	✓		✓				✓	✓	×
EE			✓	✓	✓	✓				✓	✓	✓	✓		✓				✓	✓	✓
ES				✓	✓	✓				✓	×	✓	✓	✓			×	✓	✓	✓	✓
FI				✓	×	✓				✓	×	✓	✓		✓				✓	×	✓
FR				✓	✓	✓				✓	✓	✓	✓			✓	✓	✓	✓	✓	✓
GR		✓	✓	✓	✓	✓						✓	✓		✓				✓	✓	✓
HR				✓									✓								
HU				✓	×	✓							✓		✓				✓	×	✓
IE		✓	✓	✓	×	✓					×	×	✓	✓	✓	✓				×	×
IT		×	✓	✓	×	✓				✓	×	✓	✓		✓				✓	×	✓
LT				✓	✓	×				✓	✓	✓		✓					✓	✓	✓
LU				✓	✓	✓							✓		✓				✓	✓	✓
LV																					
NL		×		✓	✓	×				✓	×	×	✓		✓				✓	×	×
NO				✓	✓	✓				✓	✓	✓	✓		✓				✓	✓	✓
PL		✓		✓	✓	×							✓						✓	✓	×
PT				✓									✓						✓		
RO		×	✓		×	×								✓						✓	✓
SE				✓	✓	✓				✓	✓	✓		×					✓	✓	✓
SI																					
SK				✓	×	✓							✓			✓	×	×	✓		✓
UK		×	✓	✓	×	×				✓	✓	✓	✓	✓	×				✓	✓	✓
Conform		5	11		15	17		0	1		8	14		5	12		1	2		15	16
Total	0	5	11	24	23	24	0	0	1	16	17	19	22	8	17	4	4	4	22	22	24
Relative (%)		100.0	100.0		65.2	70.8			100.0		47.1	73.7		62.5	70.6		25.0	50.0		68.2	66.7

Year 200-	MM			GV			PH			AQ			OZ			LF			TOTAL 2003
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	
AT	✓	✓	×	✓															5
BE	✓	✓	✓		✓	✓													7
BG			×			×						✓						✓	10
CH	✓	✓	✓			✓					✓	✓		✓	✓				8
CY																			
CZ	✓	×	×			✓													7
DE	✓	×	×	✓	×	×													8
DK	✓	✓	×		✓					✓							✓	✓	7
EE				✓															5
ES	✓	✓	✓					×	✓	✓	✓	✓		✓	✓				8
FI	✓	✓	✓	✓	✓	✓													6
FR		✓	✓					✓	✓	✓	✓			✓	✓		✓	✓	8
GR	✓	✓	✓																6
HR																			
HU	✓	×	×	✓		✓		✓	×						✓				7
IE		×	×																6
IT	✓	×	✓	✓	✓	✓					✓	✓							8
LT																			3
LU	✓	✓	✓					✓	✓	✓	✓	✓					✓	✓	7
LV																			
NL																			4
NO						✓													5
PL						×													3
PT				✓															
RO									✓										4
SE	✓	✓	✓																4
SI																			
SK																			3
UK	✓	✓	✓	✓							✓	✓							7
Conform		11	10		4	7		3	4		6	6		3	4		3	4	108
Total	14	16	17	8	5	10	0	4	5	4	6	6	0	3	4	0	3	4	146
Relative (%)		68.8	58.8		80.0	70.0		75.0	80.0		100.0	100.0		100.0	100.0		100.0	100.0	74.0

✓ Legacy Data ✓ Data conform × Data not conform

2003 status based on validated previous survey(s) 2003 status based on validated 2001 survey with 2002 survey not conform

✓ The previously confirmed data were later found to be incorrect and corrected data were re-submitted by the NFC.

This page has been left blank intentionally.

The status of the surveys of 2003 after the Conformity Check shows that all submitted surveys for Soil Condition (only 1 survey submitted), Air Quality, Ozone and Litterfall passed the tests applied. A summary of the general Conformity status of the surveys for 2003 is:

- 100 % System Installment, Soil Condition, Air Quality, Ozone, Litterfall
- >=80 - <100% Crown Condition, Soil Solution, Foliar, Phenology
- >=50 - <80% Growth, Deposition, Meteorology, Ground Vegetation
- <50% none

There is a general trend of improvement in the results of the Conformity Check of 2003 over those achieved for survey data from 2002. Only the results from the Meteorology and Ground Vegetation surveys gave lower relative figures for number of surveys passing the tests than in 2002.

4.3 Uniformity Check

To allow a meaningful interpretation of mapped data specific conditions are defined for each parameter. Some of the conditions merely define a minimum number of plots with data, e.g. the required number of plots for mapping data for Phenology and Litterfall surveys is set to 50. Others are more complex, e.g. data for Soil Solution are only mapped when the sample has been taken from the mineral soil layer with a layer depth of at least 30cm and a sampling period of no less than 300 days.

In the subsequent section only the results from those checks are presented, which allow some interpretation of a spatial or temporal uniformity of the survey data. For several validated parameters the interpretation of the results was assisted by results obtained from Level I plots for the same monitoring period or ancillary data from external sources.

4.3.1 Crown Condition

For each main tree species, mean plot defoliation is mapped for the annual data for 6 tree species (*Pinus sylvestris*, *Picea abies*, *Fagus sylvatica*, *Quercus robur* and *Q. petrea*, *Quercus ilex* and *Q. rotundifolia*, *Pinus pinaster*). The resultant maps show those plots where at least 3 trees of the respective tree species were assessed in the reporting year. For each plot, defoliation is classified according to 6 classes (0-10%, 11-20%, 21-30%, 31-40%, 41-50%, 51-100% mean defoliation).

Mean plot defoliation of *Pinus sylvestris* is shown in Figure 10. The density of validated mean defoliation data is highest in southern Sweden. The majority of the Swedish plots show a mean defoliation between 0 and 20%, but there are also several plots showing defoliation of up to 30% and two with up to 40%.

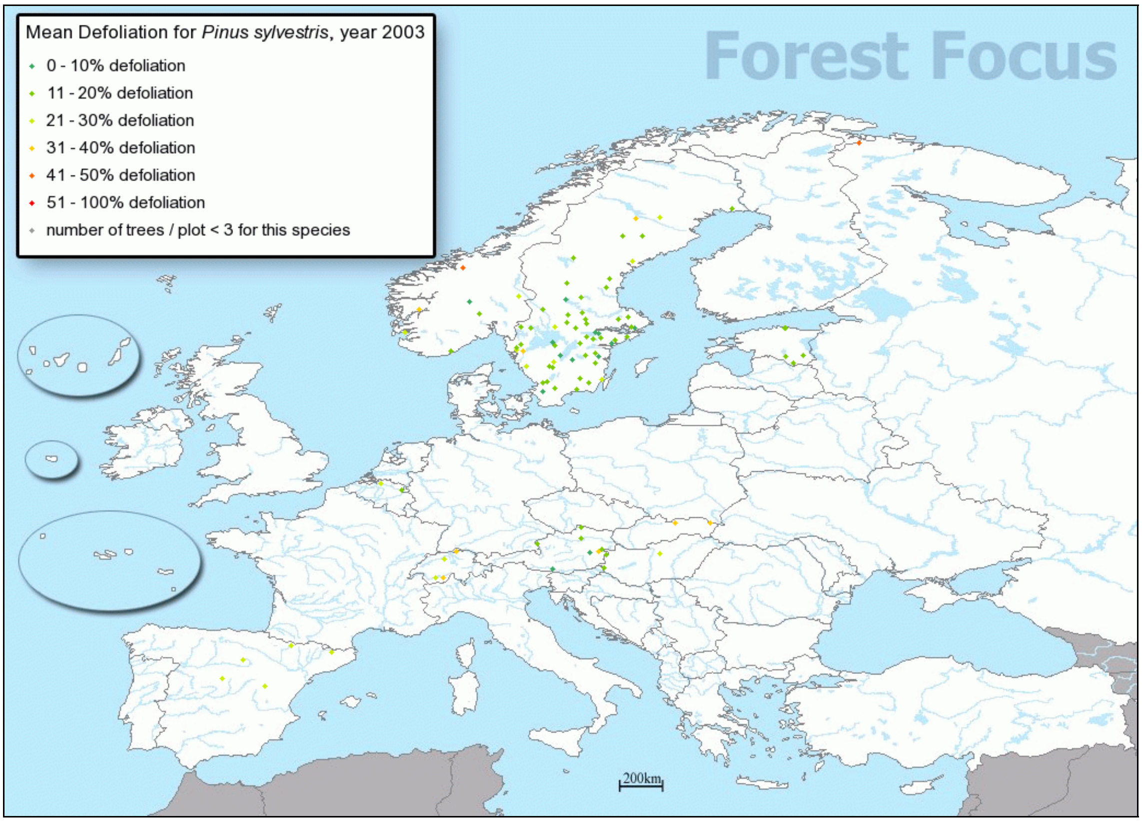


Figure 10: Mean Defoliation of Pinus sylvestris

The high density of Level II plots and their relatively small spatial variation of defoliation in southern Sweden suggest a comparison with defoliation assessed on Level I plots in that region. Most of the Level I plots show also a mean defoliation between 0 and 20%, with several plots reaching up to 30% and even to 40 % defoliation (Lorenz, *et al*., 2004). Furthermore, for a few Level I plots in southern Sweden defoliation exceeds the values found at Level II plots, ranging from 51% to 100%. Defoliation on plots in Norway, Estonia and Austria is mainly below 20%. The ancillary data does not provide evidence to reject the Level II on the grounds of spatial inconsistency. Higher levels of defoliation were reported for plots in the Slovak Republic, Switzerland and Portugal ranging from 21% to 40%. For two plots located in Norway defoliation ranging from 51% to 100% was detected.

The results of mapping mean plot defoliation of *Picea abies* are given by Figure 11. Also for this species the highest density of validated plots is found in southern Sweden, Austria and Switzerland. On most plots in southern Sweden, Austria, Belgium, Denmark and northern Italy defoliation is below 10%, but there are also several plots showing defoliation of up to 20% (except in Belgium and Denmark). The trees observed in Switzerland and in the Slovak Republic show higher levels of defoliation ranging from 21 to 30%. There is also one plot with up to 40% defoliation (in Switzerland) and two plots ranging from 51 to 100% defoliation (in Switzerland and in the Slovak Republic). Comparatively high levels of mean defoliation ranging from 41 to 100% were also reported for Norway.

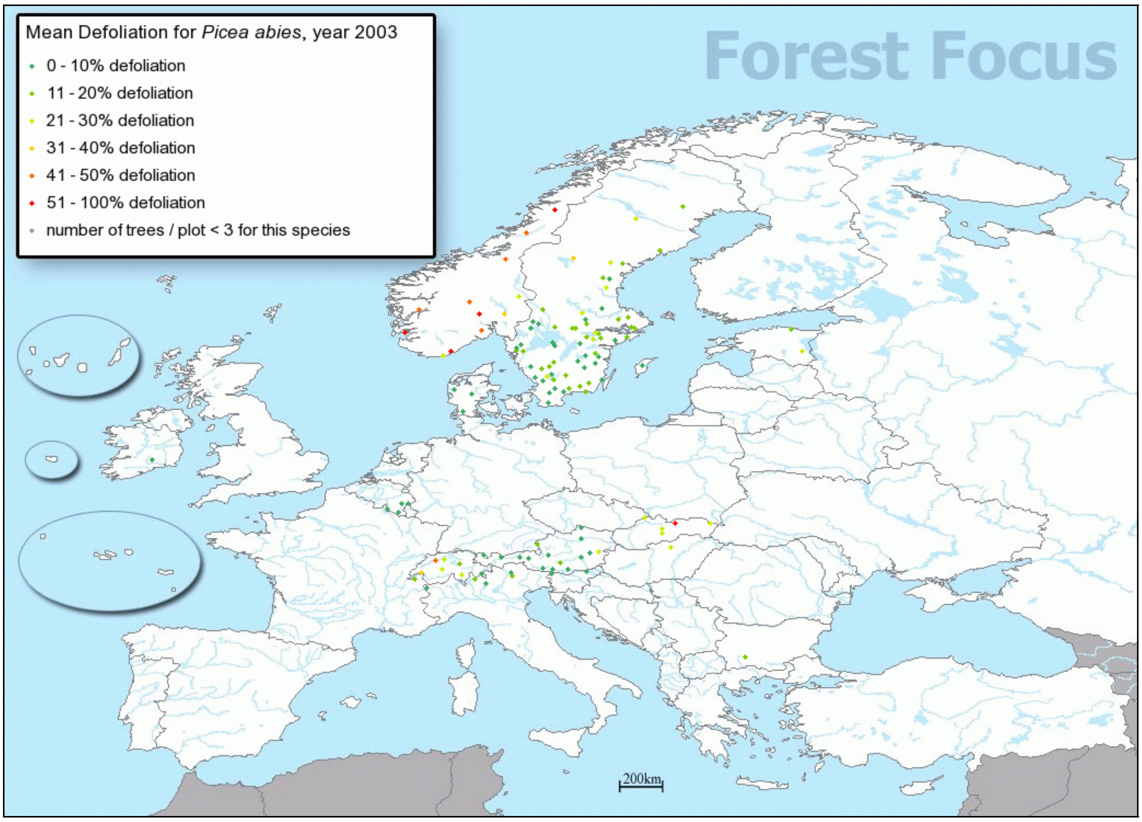


Figure 11: Mean Defoliation for Picea abies

In areas with high density of Level II plots these results are comparable to those described for the Level I plots for the year 2003 (Lorenz *et al*., 2004). One obvious exception is the high mean defoliation in Norway. The higher level of defoliation found on the Level II plots is due to the involvement of trees belonging to the social class 4 (suppressed) which are not part of the sample on Level I plots. A high proportion of those trees have had a very high degree of defoliation. Consequently, the selective nature of the Level II plots could explain the discrepancy and the data, although not homogenous, could be accepted as still uniform within the limits of the information available.

A map depicting mean defoliation of *Fagus sylvatica* is shown in Figure 12. Mean plot defoliation is lowest in Austria, Belgium, Italy and Switzerland with less than 10% on most of the plots. There are, however, several plots with up to 20%, especially in Switzerland. Plots of higher defoliation can be found in Slovak Republic, Portugal and southern Sweden where mean defoliation ranges between 11 and 40%. In three exceptional cases in southern Sweden, Hungary and Luxembourg defoliation reaches up to 50%. As far as a comparison is suggested because of high plot density, the defoliation found on Level II plots is confirmed by the results of the survey at Level I.

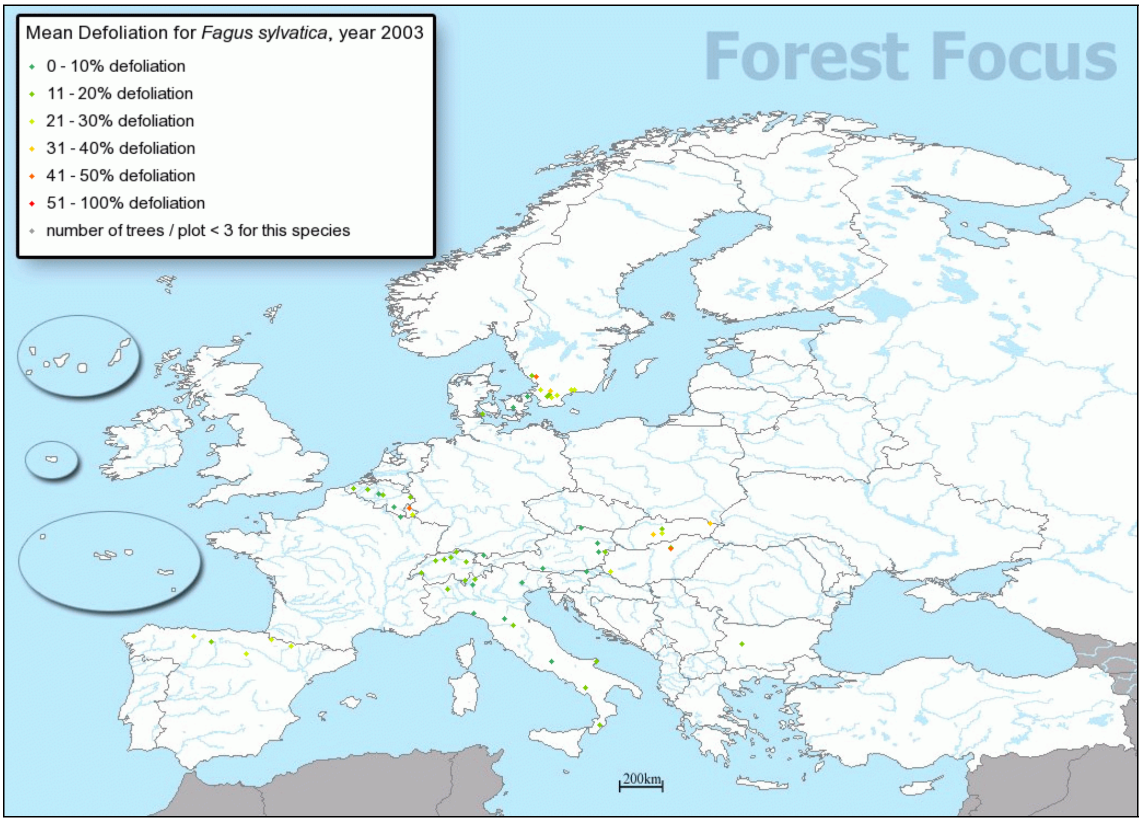


Figure 12: Mean Defoliation for Fagus sylvatica

Mean plot defoliations of *Quercus robur* and *Qu. petraea* in 2003 are mapped in Figure 13. For these species the small sample of Level II plots shows a wide range of defoliation. The overall picture is rather variable with plots in Belgium and Austria showing defoliation between 0 and 20% and defoliation between 41 and 50% on three plots located in Denmark, Italy and Hungary. Values exceeding 50% of mean defoliation were found for one plot in southern Sweden. Due to the limited geographic spread and the limited number of Level II plots as well as the high spatial variation a comparison with the results of the assessment on Level I plots would of little consequence.

The very limited number of plots with validated data does not allow a meaningful interpretation of the situation for the following checks:

- Mean Plot Defoliation of *Quercus ilex* and *Qu. rotundifolia*
- Mean Plot Defoliation of *Pinus pinaster.*

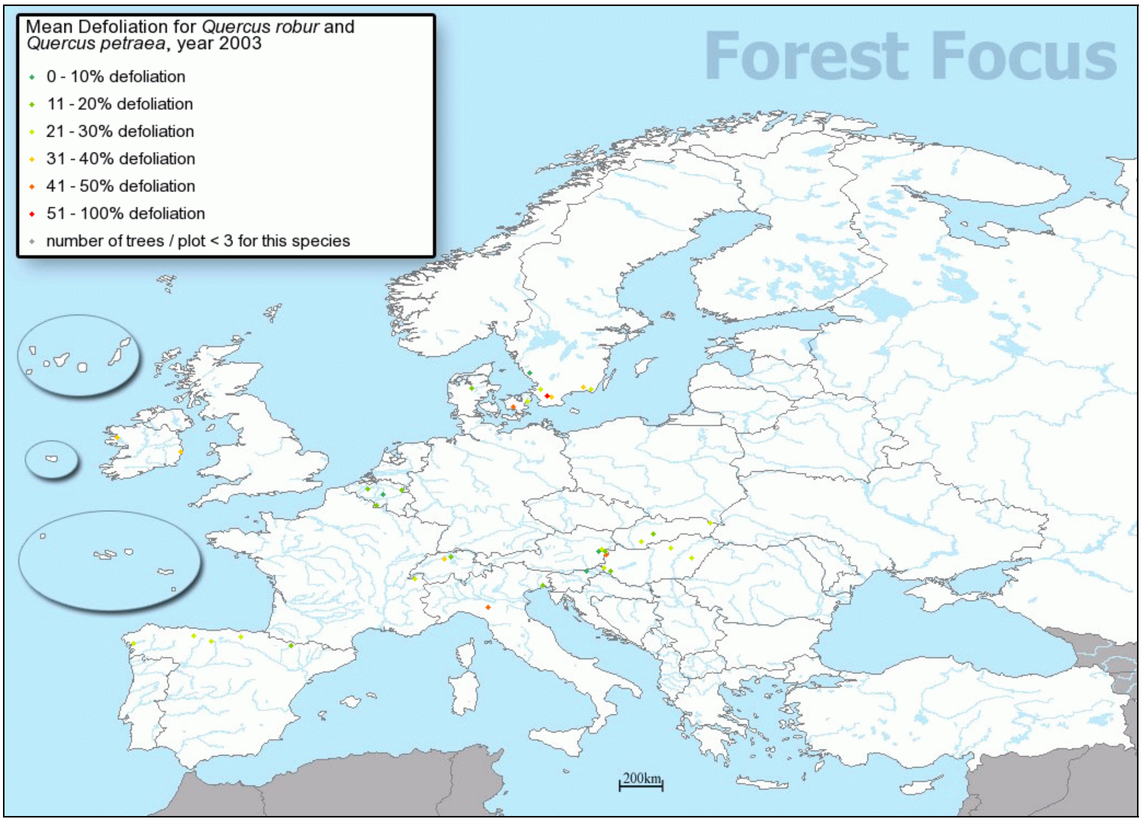


Figure 13: Mean Defoliation for Quercus robur and Qu. petraea

4.3.2 Soil Condition

This Soil Condition survey parameter map in Figure 14 depicts the pH ($CaCl_2$) for the upper mineral layer per plot is shown. The graph depicts pH values for the latest available year for each plot. In 2003 new data were submitted by Bulgaria. The pH values are taken from the layer M01 (0-10cm), alternatively from layers M05 (0-5cm) and M51 (5-10cm), or from the M02 (0-20cm) layer in this order.

The majority of plots show pH-values between 3 and 4. These plots can be mainly found in central Europe and in Scandinavia. Level II plots with lowest pH-values (around 3) are located in central Europe, while most plots with high pH-values (around 6) can be found in the Mediterranean region or in the Alps. The high pH-values in the Alps result from the buffer capacity of calcareous soils. In the Mediterranean region depositions of Saharan dust yield a high buffering capacity of the soils. For plots in Germany, Austria, Switzerland and the eastern part of France a high variability of pH-values is reported ranging between 2 and 7. A few plots with pH-values above 7 were observed in Spain, United Kingdom, in the east of France, Switzerland, Austria, Slovak Republic and Hungary. The rough spatial pattern of soil-pH analysed by Level II plots coincides with the findings derived from the Level I soil survey (Augustin *et al*. 1997).

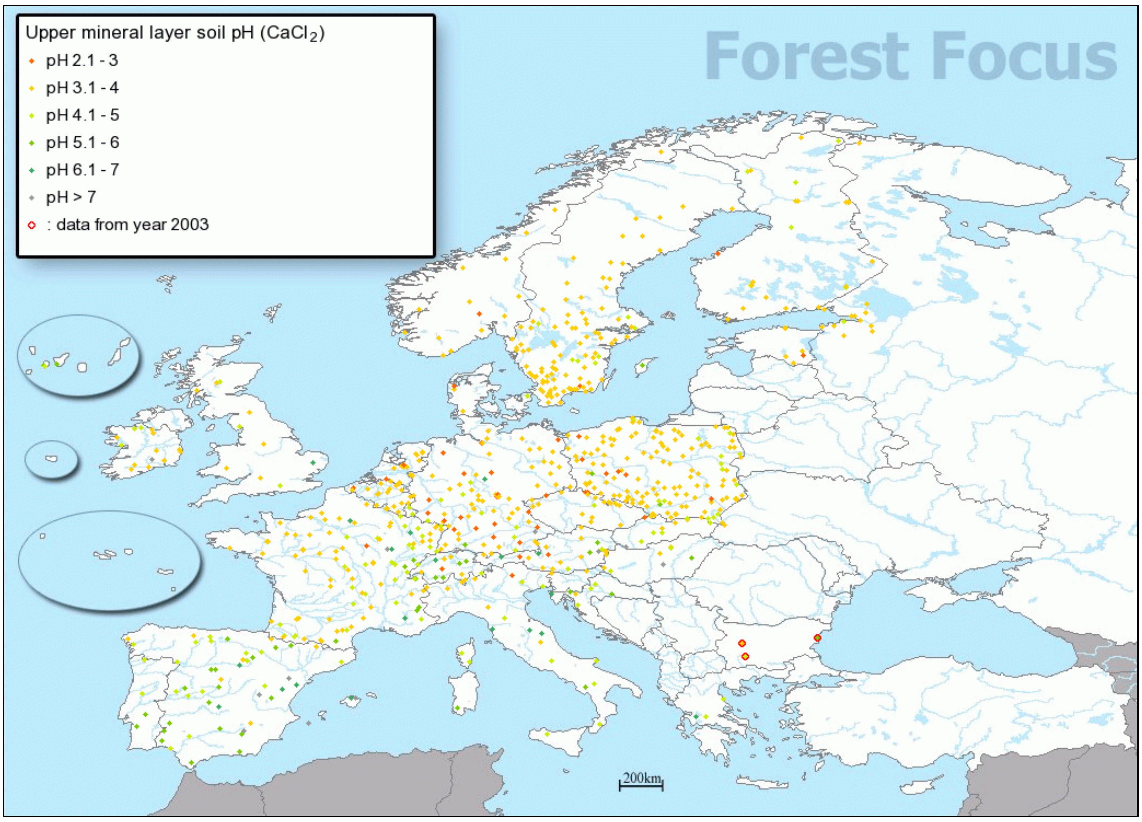


Figure 14: pH ($CaCl_2$) for the Upper Mineral Layer

4.3.3 Soil Solution

For identifying the validity of concentrations of the three soil solution compounds sulphur ($S\text{-}SO_4$) and nitrogen ($N\text{-}NO_3$ and $N\text{-}NH_4$) changes in the values reported for previous monitoring years are assessed. The difference between the time-weighted mean concentration in the reporting year and the average of the weighted mean concentration of the five preceding years is evaluated as part of the tests. Not all Soil Solution data stored in the FFMDb are necessarily mapped. For plots displayed on the map the following conditions apply:

- the sample has to be taken from the mineral soil layer;
- the layer depth must be at least 30 cm;
- the total sample period must be more than 300 days.

The corresponding data for 2003 for the compound $S\text{-}SO_4$ is presented in Figure 15. For plots located in Norway, Finland, Estonia, Austria and France the $S\text{-}SO_4$ concentration ranges between 51% and 125% of the average concentration measured for the previous five years. The highest variability for $S\text{-}SO_4$ concentrations ranging between below 50% and 150% was reported for plots in United Kingdom. Furthermore for one plot in Finland the reported concentration is above 150% of the average concentration measured for the previous five years. For several plots located in Finland, Italy and Portugal no values were available for any of the previous five years.

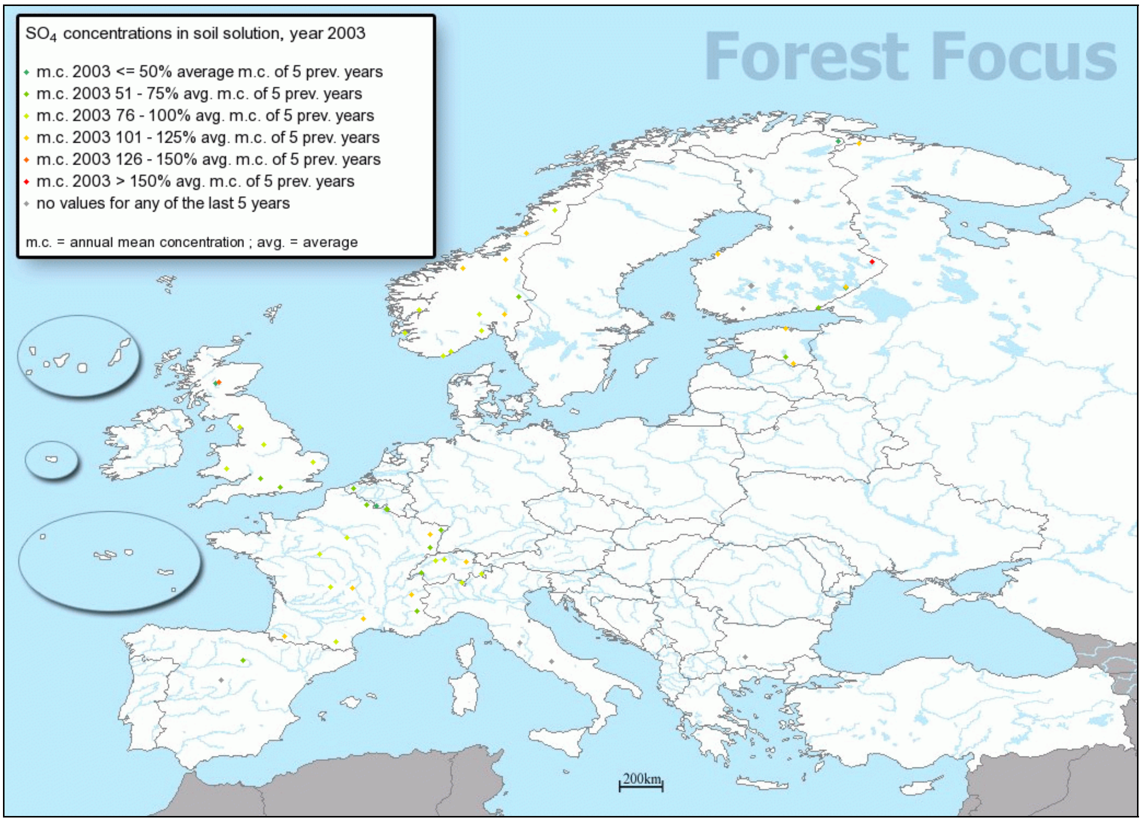


Figure 15: SO_4 Concentrations in the Soil Solution

The concentrations of $N\text{-}NO_3$ are mapped in Figure 16. The majority of nitrate concentrations observed in Norway and on several plots located in United Kingdom, France and Italy are below 50% of the average concentration measured for the previous five years. For plots in Estonia, Switzerland and France $N\text{-}NO_3$ concentrations between 101% and 125% were reported. Several plots with nitrogen concentrations above 150% were found for plots in the United Kingdom and France. In Switzerland, Finland and Norway one plot with concentrations above 150% was found each. For almost all plots in Finland no values for any of the last five years were available.

The data recorded for the parameter $N\text{-}NH_4$ of the Soil Solution survey is shown in Figure 17. Data are mapped for plots in Finland, United Kingdom, France, Belgium and one plot in Switzerland and Italy respectively. A high variability of $N\text{-}NH_4$ concentrations was detected for plots in United Kingdom ranging between below 50% and above 150% of the average concentration measured for the previous 5 years. For several plots located in France and one plot in Belgium concentrations above 150% were reported.

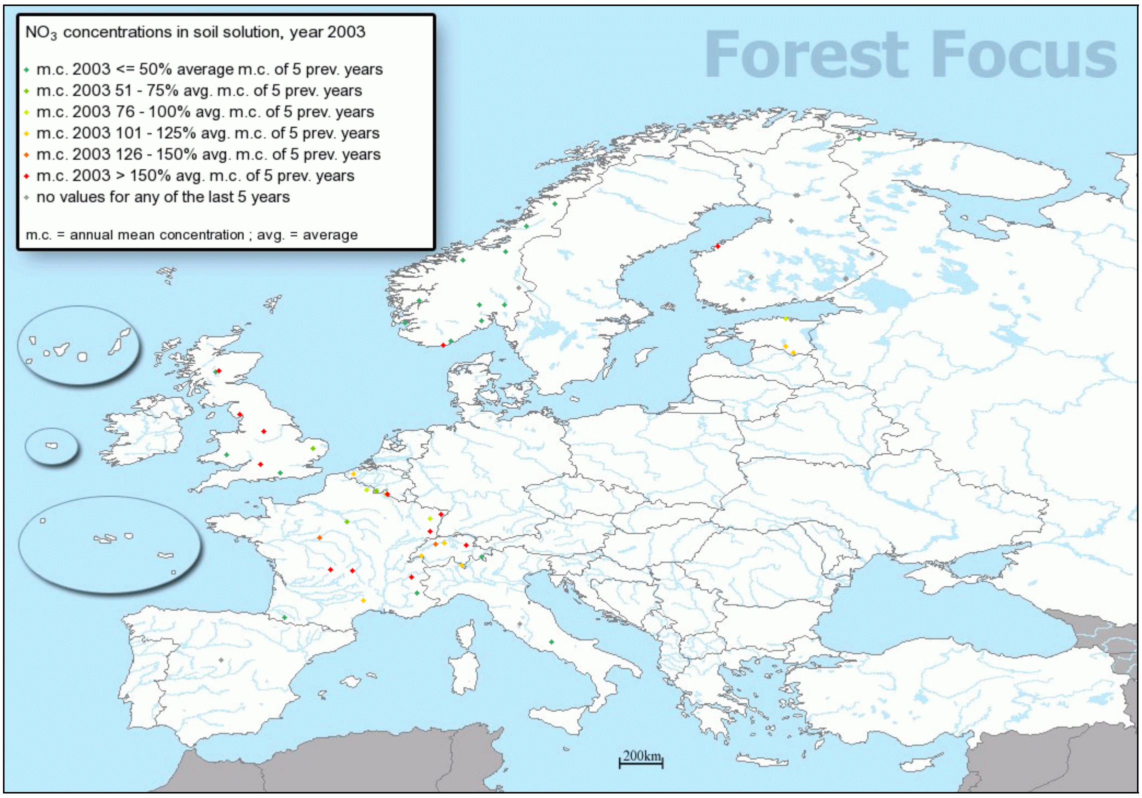


Figure 16: NO_3 Concentrations in the Soil Solution

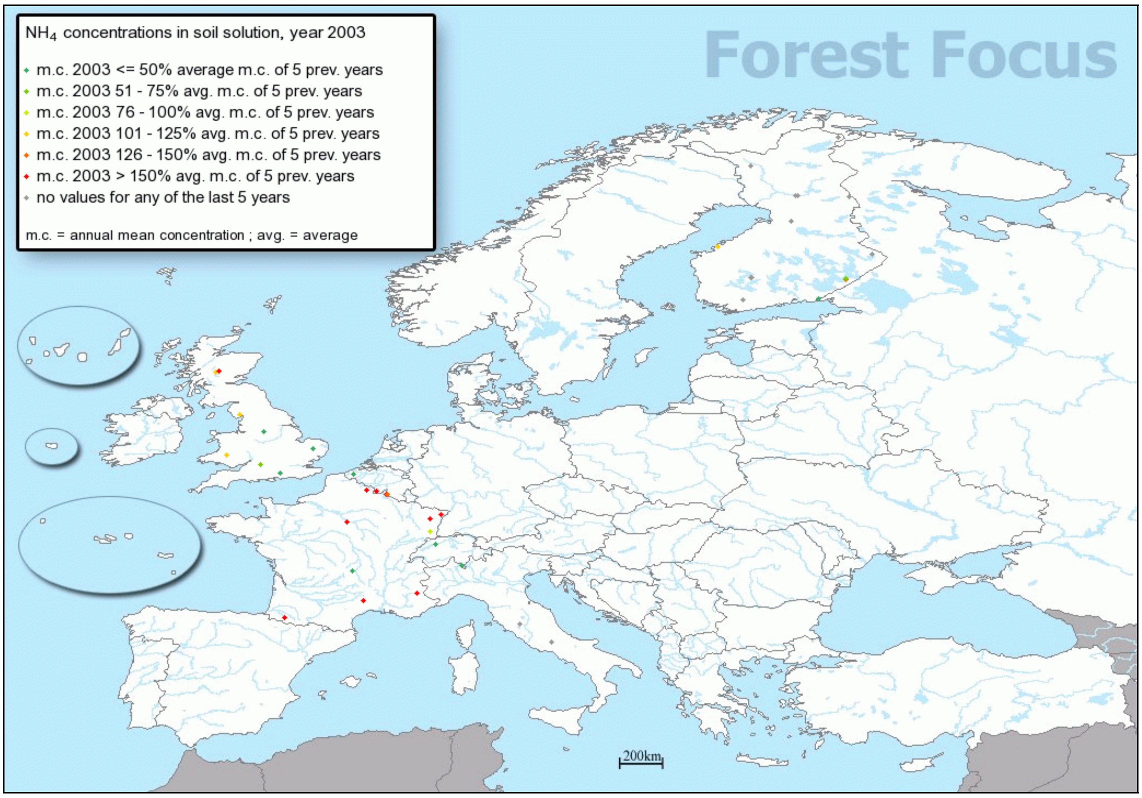


Figure 17: NH_4 Concentrations in the Soil Solution

4.3.4 Foliar Condition

The concentrations of chemical elements found in leaves constitute important response parameters for air pollution effects. Plotting their spatial variation can give hints on the completeness and correctness of measurements in the participating countries. Concentrations of nitrogen and sulphur are mapped for *Pinus sylvestris*, *Picea abies*, *Fagus sylvatica*, *Quercus robur* and *Q. petraea*, *Quercus ilex* and *Qu. rotundifolia*, and *Pinus pinaster* (tree species coded in field “sample number”). For each reporting year, mean plot concentrations are calculated by species and plot and are then classified into five classes of equal relative frequency (pentiles). The minimum of the first class is the minimum of the depicted values, the maximum of fifth class is the maximum of depicted values.

As the Foliar survey is only assessed every two years the amount of data for 2003 is limited and therefore does not allow a meaningful interpretation of the situation for the following checks:

- Foliar Nitrogen Concentrations for *Pinus sylvestris*
- Foliar Sulphur Concentrations for *Pinus sylvestris*
- Foliar Nitrogen Concentrations for *Picea abies*
- Foliar Sulphur Concentrations for *Picea abies*
- Foliar Nitrogen Concentrations for *Fagus sylvatica*
- Foliar Sulphur Concentrations for *Fagus sylvatica*
- Foliar Nitrogen Concentrations for *Quercus robur* and *Qu. petrae*a
- Foliar Sulphur Concentrations for *Quercus robur* and *Qu. petraea*
- Foliar Nitrogen Concentrations for *Quercus ilex* and *Qu. rotundifolia*
- Foliar Sulphur Concentrations for *Quercus ilex* and *Qu. rotundifolia*
- Foliar Nitrogen Concentrations for *Pinus pinaster*
- Foliar Sulphur Concentrations for *Pinus pinaster*.

The limited number of data available for the reporting year 2003 is presented for *Picea abies* as an example in Figure 18. The few plots on which foliar concentrations of nitrogen in needles were assessed are located in Norway, Finland, Estonia, Hungary, Italy and Bulgaria. Measured nitrogen concentrations range from 9.0 to 17.1 g/kg. The highest nitrogen concentrations ranging from 13.0 to 17.1 g/kg are measured on plots in Italy, on two plots in Finland and one plot in Hungary and Italy each. Concentrations are lowest in northern Europe. These are the plots situated in Norway and Finland. The majority of nitrogen concentrations in this area are the concentrations of the two lowermost percentiles ranging from 9.0 to 11.3 g/kg.

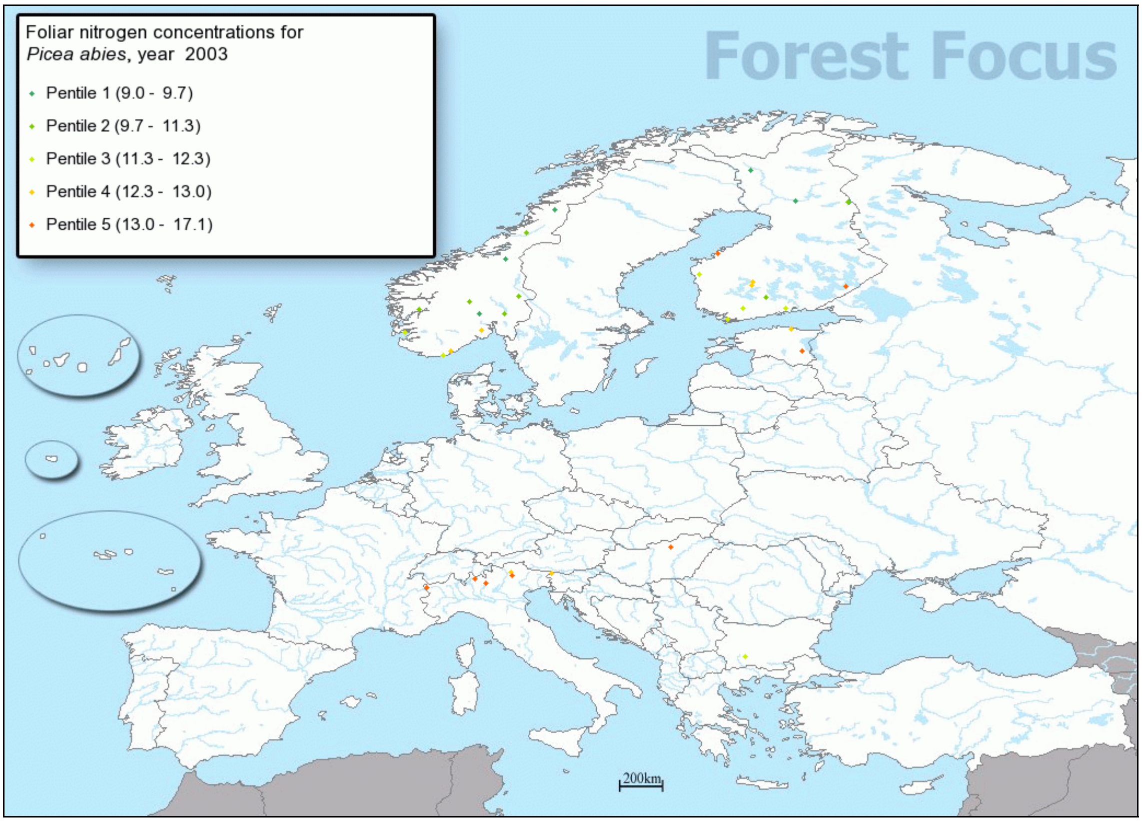


Figure 18: Foliar Nitrogen Concentrations for Picea abies

4.3.5 Growth Assessment

To assess the uniformity of tree dimensions and forest growth the mean basal area per plot is used. The temporal consistency is validated by using the mean annual increment of basal area per plot, which is calculated from repeated measurements.

- *Mean basal area* [m^2] is mapped based on the most recent data for each plot (submitted with form IEV, first group of "basal area per plot" and "volume per plot"). Mean basal area is classified into five classes with 20% of relative frequency each (pentiles, with: minimum of first class = minimum of values, maximum of fifth class = maximum of values). The map for mean basal area shows, when appropriate, the data of the latest available year for each plot, but specifically indicates plots with data submission in the reporting year.
- *Mean basal area increment* [m^2] is mapped per plot and year, based on the most recent (five years) measurement period. For each plot, mean annual basal area increment is classified into five classes with 20% of relative frequency each, as is mean basal area. Mapped is the mean annual increment of the latest available (five years) period for each plot with available data, but specifically indicates plots with data submission in the reporting year.

Forest growth is further validated by an index comparable to basal area calculated from the values of diameter (at breast height, dbh) parameter as reported in the IPM form.

Contrary to the mean basal area taken from the IEV form the derived index comprises a unitless value independent of the size of the plot. The calculation of the index first sums up the tree specific area from the dbh values, using the mean diameter of the two values given in the form:

$$BA = \frac{\sum dbh^2 \times \frac{\pi}{4}}{sample \quad plot \quad size}$$

The mean for the plot is then obtained by dividing the dbh area sum by the sample plot size. A restriction for this calculation is that either

- the number of trees in this calculation (number of observation in the IPM file for this plot and year) is equal to the number of trees on the plot which is submitted in the form PLI (plot file for growth) AND the sample plot size is equal to the total plot size (both submitted with PLI) OR
- the number of trees in this calculation divided by total number of trees (PLI) is +/- equal to the quotient of sample plot size (PLI) and total plot size (PLI).

Restriction (1):

number of observations (IPM) per plot and year ≈ number of trees in total plot (PLI) AND sample plot size (PLI) ≈ total plot size (PLI); in both comparisons the deviation should be not more than 10% of the lower values in the equation.

Restriction (2):

number of observations (IPM) / number of trees in total plot (PLI) ≈ sample plot size (PLI) / total plot size (PLI); the deviation should be not more than 10% of the lower value in the equation.

In case that the number of trees, the scale of the values or any other basic parameter deviates between two subsequent data submissions for a particular plot the division by the corresponding (constant) sample size will lead to a high change in basal area, which will allow for a more detailed check of the respective data. As in case of the mean basal area the calculated basal area index is mapped for data of the monitoring year and as an increment for the increment over the most recent measurement period.

Data should be mapped for the following parameters:

- mean basal area per plot, based on increment information (IEV);
- 5-year mean basal area increment per plot, based on increment information (IEV);
- calculated basal area, based on periodic data (IPM);
- 5-year calculated basal area increment, based on periodic data (IPM).

In Figure 19 the mean basal area per plot is presented. Plots with available growth data in 2003 were found in France, Spain and one plot in Portugal. A high heterogeneity of mean basal area was reported for these regions ranging from 1.616m²/ha to

56.382m²/ha. This can be explained by different tree species, tree ages and site conditions. Furthermore forest management has important impacts on forest growth.

Due to the very limited number of plots with validated data no further parameters describing forest growth can be shown.

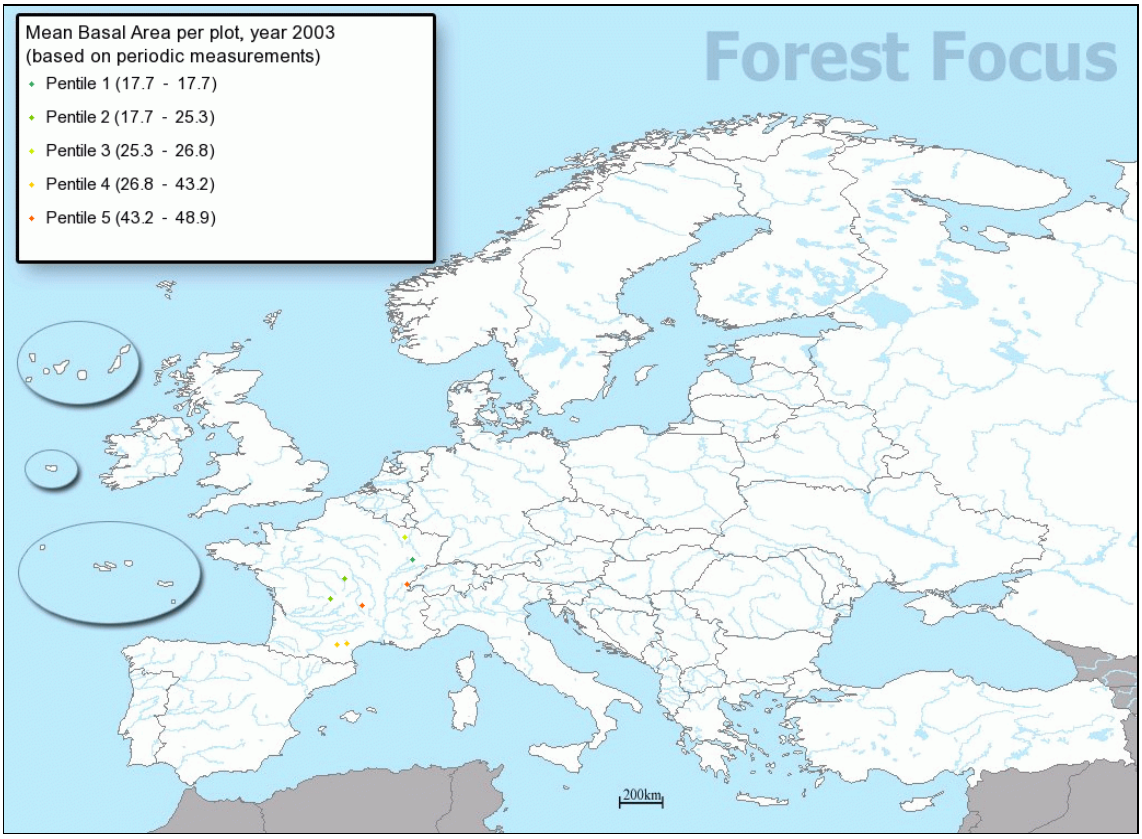


Figure 19: Mean Basal Area per Plot (periodic measurements)

4.3.6 Deposition

Validating Uniformity for data of the Deposition survey is based on contrasting the values reported for S-SO_4, N-NO_3 and N-NH_4 in two series of maps. The first series shows the plot-wise quantity weighted (volume of sampled precipitation) mean concentration of bulk deposition for S-SO_4, N-NO_3 and N-NH_4 in mg/l for the particular reporting year. The value is calculated as:

$$Quantity-weighted\quad mean\quad concentration_{dep} = \frac{\sum deposition \times quantity_{dep}}{\sum quantity_{dep}}$$

The calculations of quantity weighted mean concentration is necessary, because various instances of periodic measurements are submitted for a particular year. The calculations are only applied to data of plots for which data were submitted for at least 300 days (plot specific sum of period lengths in the PLD form). The resulting mean concentrations are grouped into 5 classes with 20% of relative frequency (pentiles, minimum of first class = minimum of values, maximum of fifth class = maximum of values). Extreme values in relation to values of surrounding plots are in the focus of the validating expert.

Within the interpretation, precipitation of the respective year has to be taken into account as a major additional influence on the concentrations. The purpose of this second series of maps is intended to reveal sudden changes in concentrations of the depositions related to the amount of water (quantity of precipitation) in the bulk deposition.

The difference between the quantity weighted mean concentration in the reporting year (first series) and the average of the weighted mean concentrations of five preceding years is presented for the reporting year. The differences are grouped into five equidistant classes; minimum of 1st class is {-1*[max(-1*min;max)]}, maximum of 5th class is [max(-1*min;max)]. The analysis focuses on the description of observed spatial patterns of high / low deposition and will compare the monitored deposition levels with those for external data (if available) and former years.

The quantity-weighted mean S-SO_4 concentrations in bulk deposition for 2003 are given in Figure 20. Plots of highest S-SO_4 concentrations can be found in Belgium, Slovak Republic, Hungary and Romania ranging from 0.8 to 2.14 mg/l. For plots located in Norway, Finland, Estonia, France, Switzerland and Spain lowest sulphate concentrations ranging from 0.06 to 0.42 mg/l were reported. The depositions measured in Sweden, the United Kingdom, Italy and Greece are an order of magnitude below those reported for areas of high input such as on plots in Belgium but higher than most of the plots located in Norway and Austria.

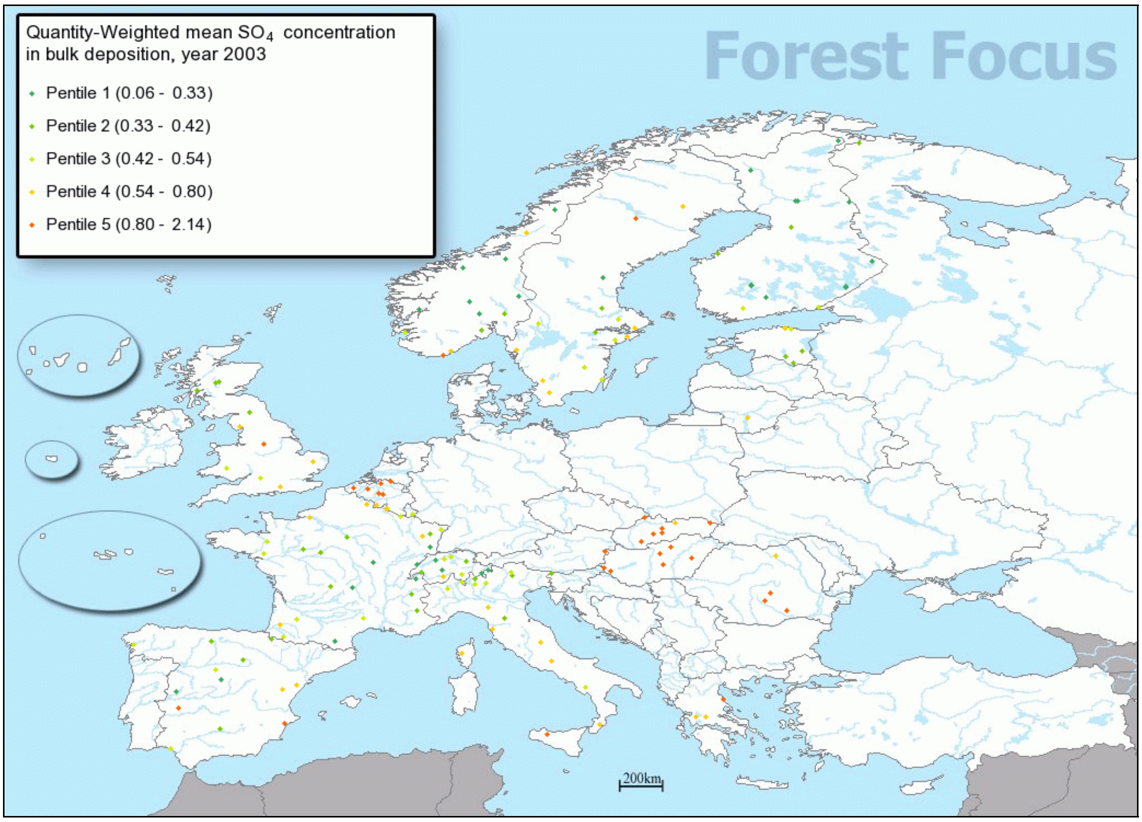


Figure 20: Quantity-Weighted Mean SO_4 Concentration in Bulk Deposition

EMEP, the Co-operative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe regularly publishes modelled and interpolated sulphur and nitrogen deposition values. These data for Europe are based on a 50km x 50km grid and are shown in Figure 21 and in Figure 23. The respective maps and deposition values are not directly comparable with the concentration values as reported and displayed for Level II plots.

The general distribution of S-SO_4 concentrations presented by EMEP data (Figure 21) is similar to that found for Level II plots. The lowest deposition values range between 50 and 200 mg(S)/m² and can be found in Norway and the northern part of Sweden. Depositions between 200 and 500 mg(S)/m² were reported for plots located in Finland, Switzerland and Spain. A high level of sulphur depositions ranging between 1,000 and 2,000 mg(S)/m² can be found for example in Belgium and the Slovak Republic.

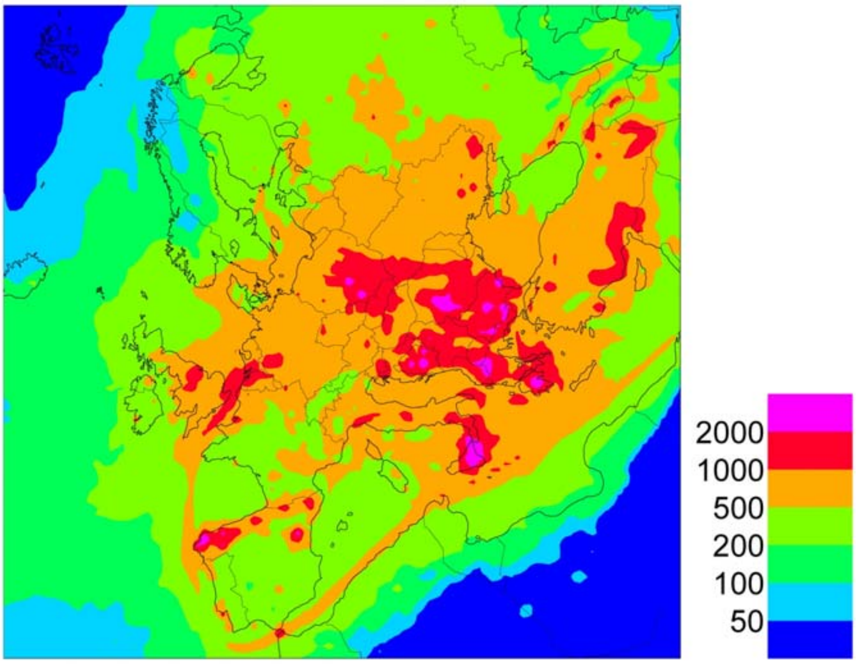


Figure 21: Deposition of Sulphur (mg(S)/m²) for 2003

Source: EMEP Status Report 2006, Transboundary Acidification, Eutrophication and Ground Level Ozone in Europe from 1990 to 2004 in support for the review of the Gothenburg Protocol. Norwegian Meteorological Institute 2006

The quantity-weighted nitrogen concentrations in bulk deposition are shown in the Figure 22 and Figure 24. The spatial pattern of these data is similar to those of the sulphur concentrations. The highest $N\text{-}NO_3$ concentrations ranging from 0.53 to 3.04 mg/l were observed on almost all plots in Belgium and on several plots in Sweden, Italy, Slovak Republic and Hungary. The same spatial distribution applies or $N\text{-}NH_4$ concentrations (Figure 22). The highest $N\text{-}NH_4$ concentrations are between 0.86 and 2.48 mg/l (Figure 24). Plots with lowest concentrations of the two nitrogen compounds are most frequent in Norway, Finland, the United Kingdom, France and Spain. Low nitrate concentration can also be found in Estonia.

Figure 23 presents the nitrogen depositions produced by EMEP. The general distribution of the EMEP data and the values reported for Level II plots are not contradictory. The comparatively high values ranging between 500 and 1,000 mg N/m² in Belgium, southern Sweden, Italy and Slovak Republic are reflected in the nitrogen deposition data. Moreover, most of the Level II plots with low nitrogen concentrations are in accordance with the deposition data ranging between 200 and 500 mg N /m².

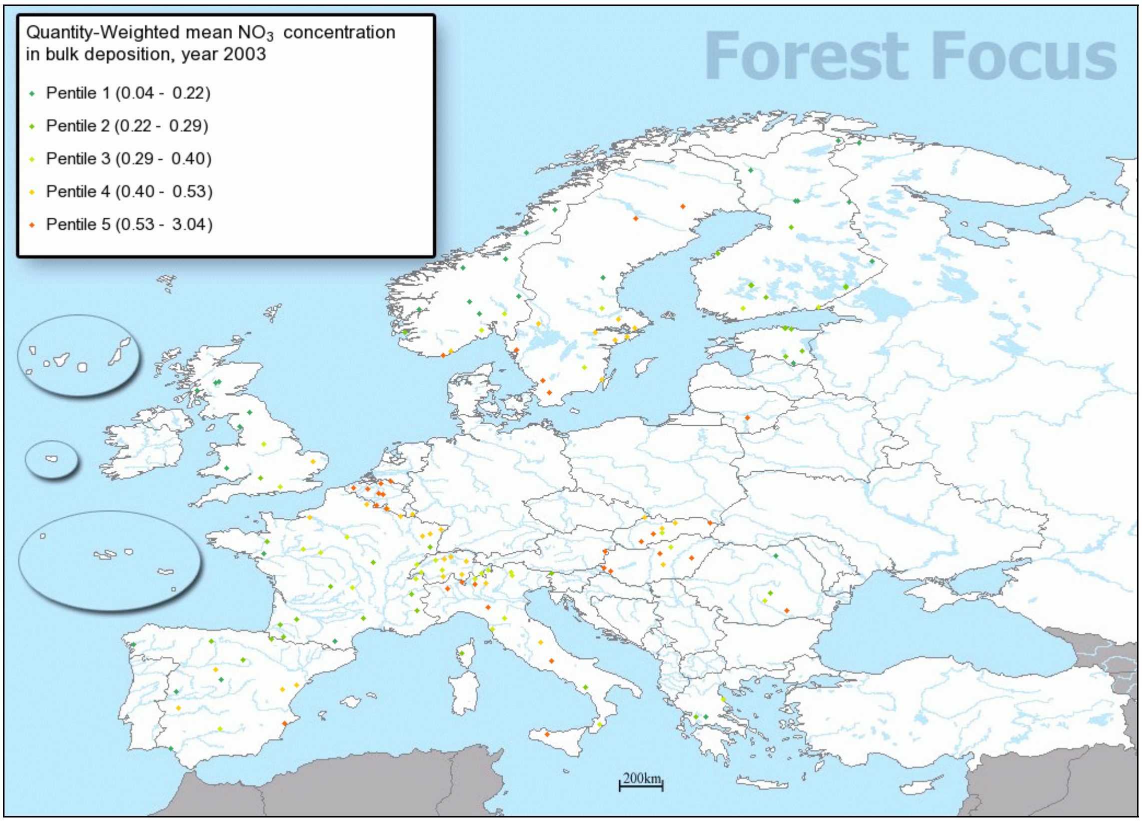


Figure 22: Quantity-Weighted Mean NO_3 Concentration in Bulk Deposition

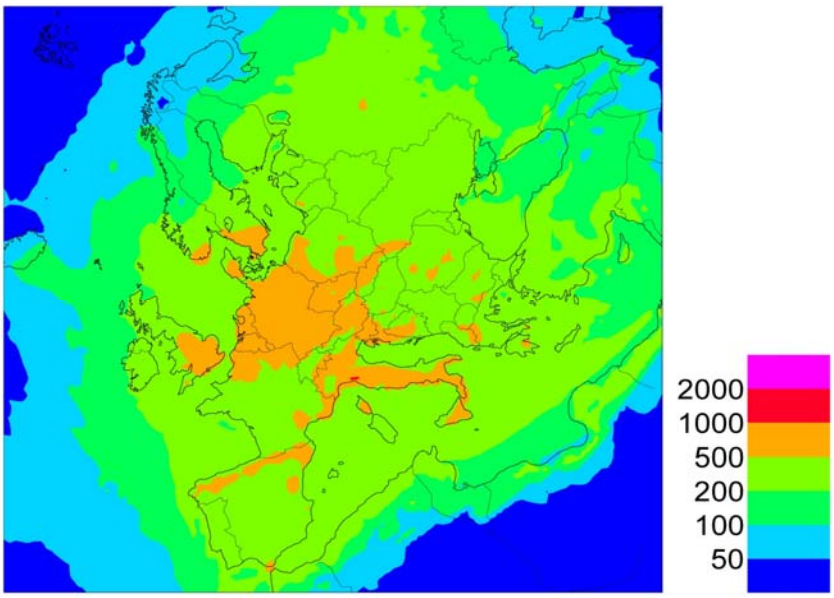


Figure 23: Deposition of Oxidised Nitrogen (mg (N)/m^2) for 2003

Source: EMEP Status Report 2006, Transboundary Acidification, Eutrophication and Ground Level Ozone in Europe from 1990 to 2004 in support for the review of the Gothenburg Protocol. Norwegian Meteorological Institute, 2006

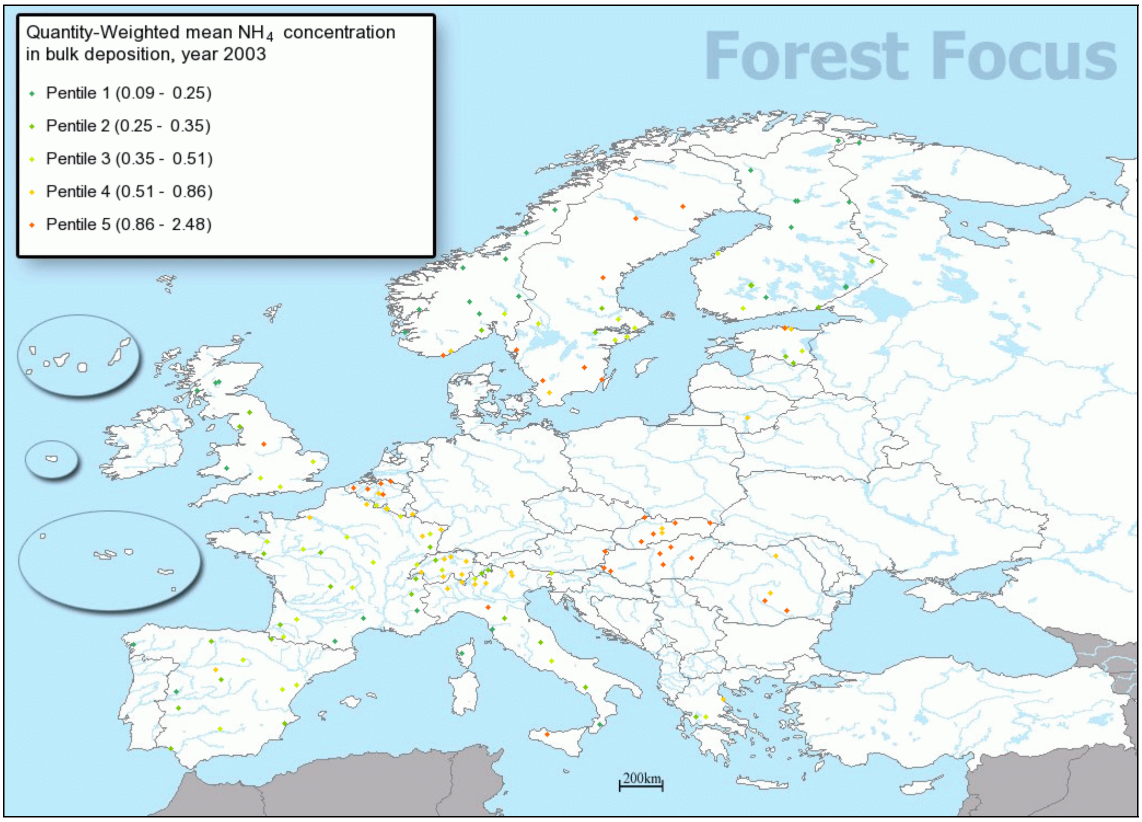


Figure 24: Quantity-Weighted Mean NH_4 Concentration in Bulk Deposition

The data for deviations in the quantity-weighted mean depositions of the monitoring year 2003 from the average deposition reported over the previous 5 years are mapped for the three selected parameters in Figure 25 ($S\text{-}SO_4$), Figure 26 ($N\text{-}NO_3$) and Figure 27 ($N\text{-}NH_4$). For a small number of scattered plots the element concentrations in bulk deposition for the three parameters are below 50% of the average values of the previous 5 years such as in Estonia and Spain. For the majority of plots the values range between 76% and 125%. A small number of plots show an increase in concentrations above 150% in comparison to the previous five years such as in Sweden, Norway and Switzerland. Increasing $N\text{-}NH_4$ concentrations are obvious for several plots located in Sweden, Norway and Switzerland. The 2003 values were not found to be outside the range of observations and do not give grounds for doubting the uniformity of the data.

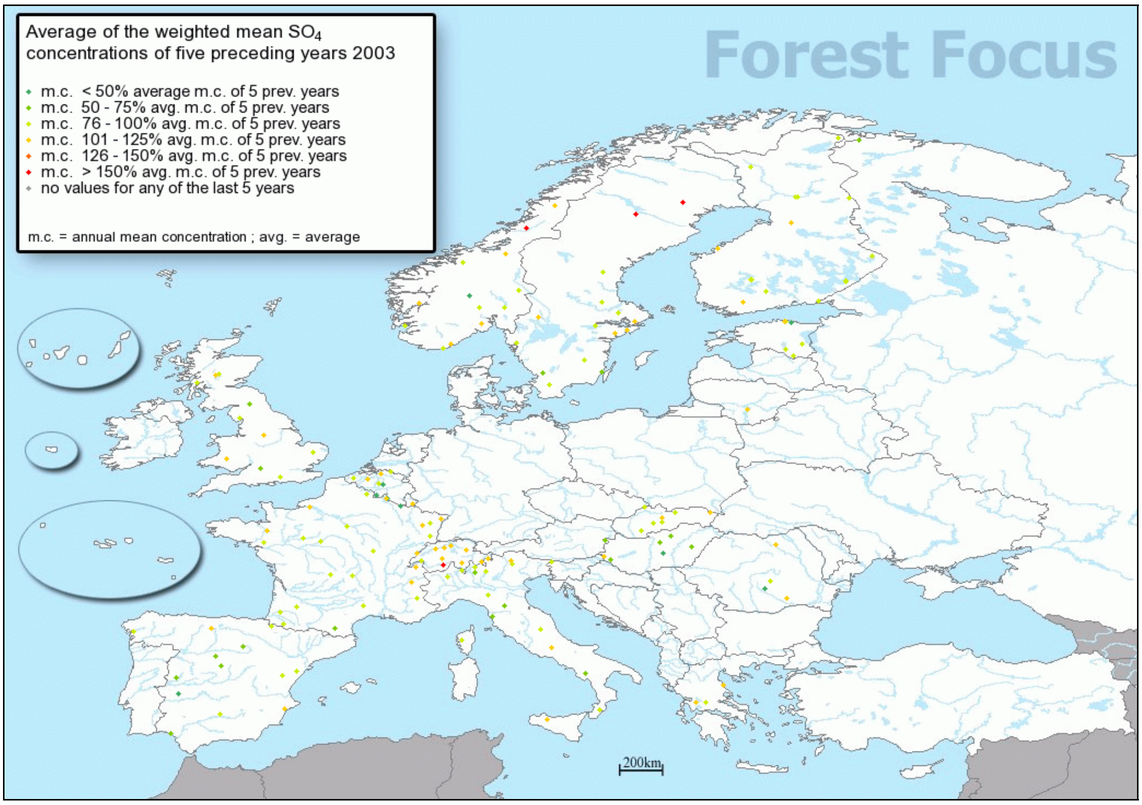


Figure 25: Average of the Weighted Mean SO_4 Concentration of 5 Preceding Years

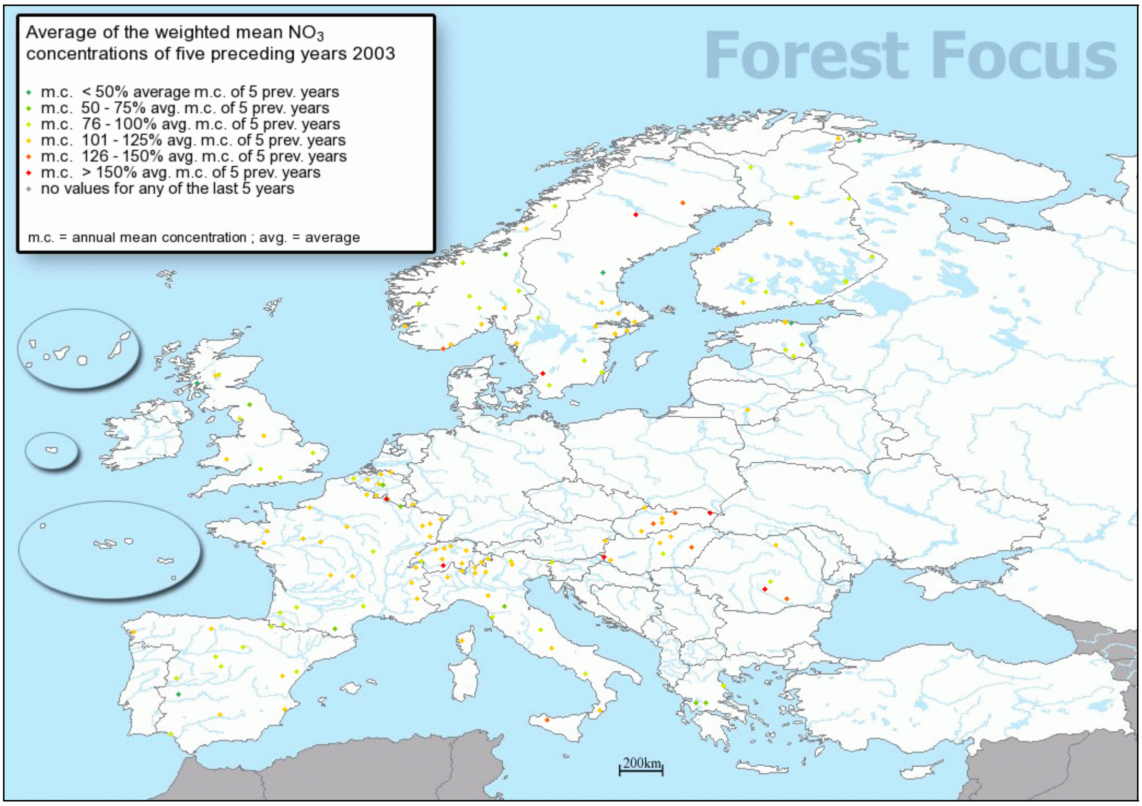


Figure 26: Average of the Weighted Mean NO_3 Concentration of 5 Preceding Years

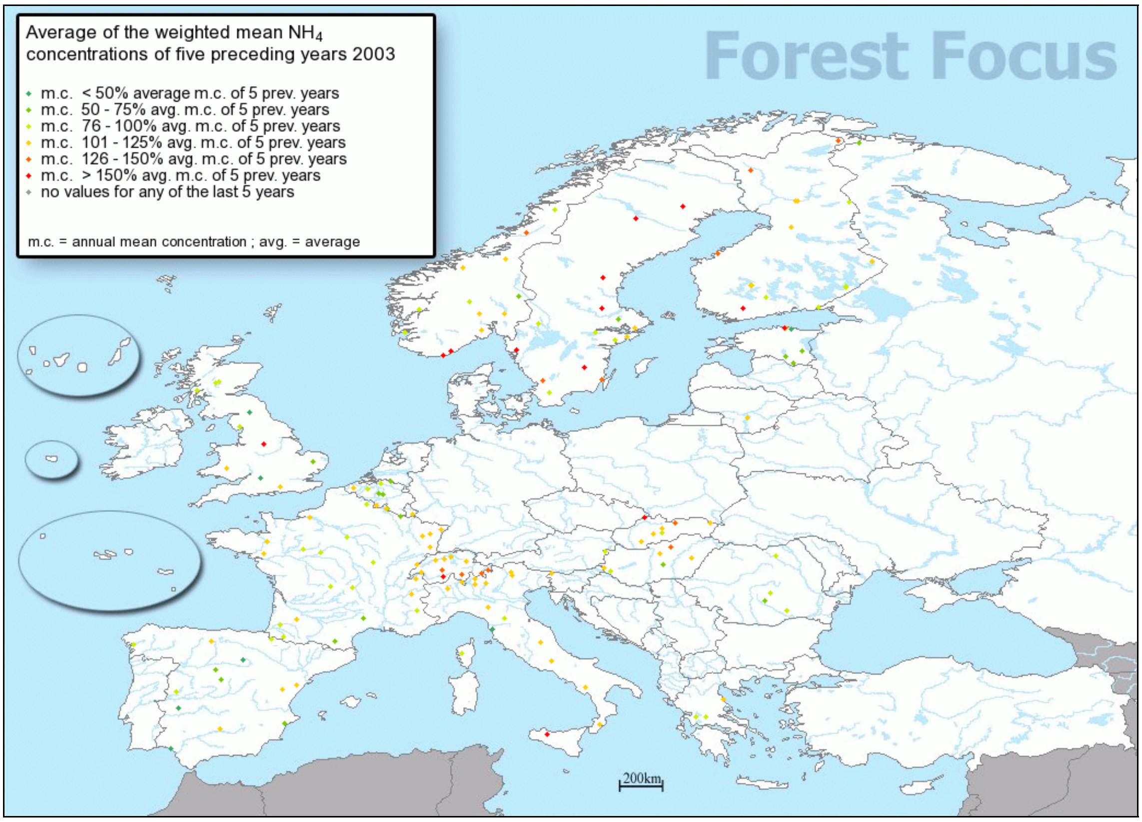


Figure 27: Average of the Weighted Mean NH_4 Concentration of 5 Preceding Years

4.3.7 Meteorology

Temperature and precipitation have probably the largest influence on forest condition. For the Level II plots of the year 2003 the parameters total annual precipitation (mm) and mean annual temperature (°C) are mapped to validate data uniformity. For display purposes the data are grouped into 5 pentiles with 20% of relative frequency. Data were plotted in the map under the following conditions:

- Sum of precipitation and mean daily air temperature had to be measured for at least 300 days (continuity during year);
- Precipitation and air temperature measurements of at least 90% per day (continuity during day).

The distribution of the mean annual temperature of plots with appropriate data is shown in Figure 28. Temperatures were mapped for plots in Sweden, Finland, Belgium, Switzerland, Italy, Greece, France, United Kingdom and Spain. The mean annual temperature ranges between -0.5 and 16.9°C and does not show any particular deviations from the general pattern of the distribution of temperatures in Europe, which could not be explained by local conditions of plot aspect and elevation.

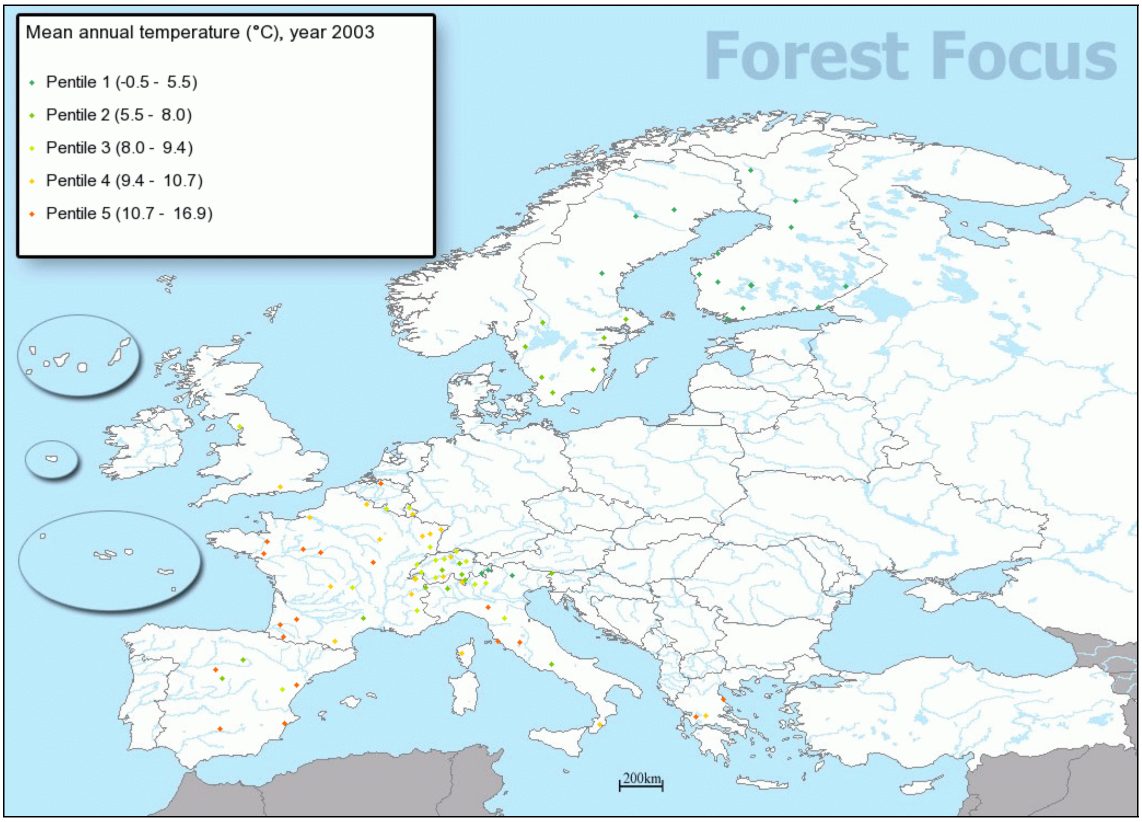


Figure 28: Mean Annual Temperature (°C)

The total annual precipitation is shown in Figure 29. Plots with available precipitation values could be mapped for the same countries as for mean annual temperatures except Finland. For plots located in Switzerland, Italy, France, Greece and one plot in the United Kingdom highest values of total annual precipitation ranging from 1,202 to 2,744 mm were observed.

The precipitation map offered by the Global Precipitation Centre (GPCC) is shown in Figure 30. For a comparison of total annual precipitation measured at Level II plots, the monthly averages of the GPCC precipitation values have to be scaled to an annual figure. The lower precipitations for several plots located in Sweden, Luxembourg, Switzerland, the northern part of France and Spain match with the general pattern. The mentioned higher precipitation values observed on several Level II plots were not confirmed by the GPCC data, probably due to the low resolution of these data.

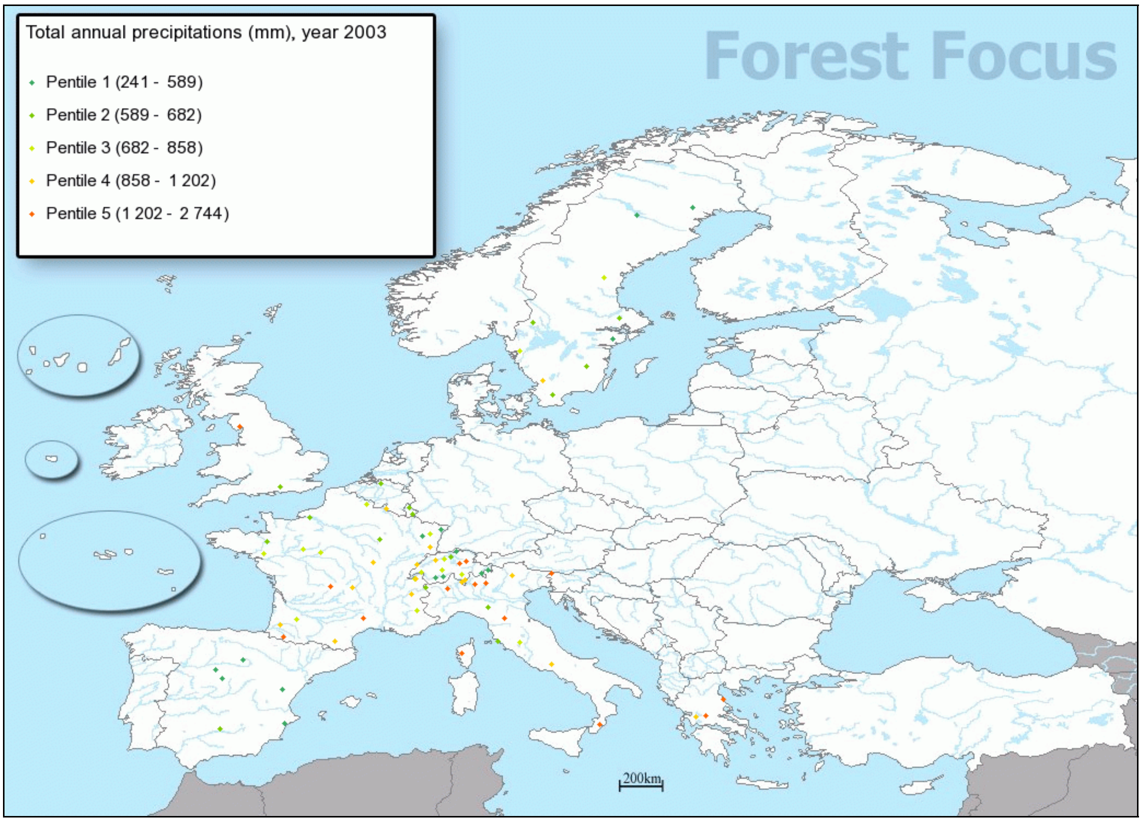


Figure 29: Total Annual Precipitations (mm)

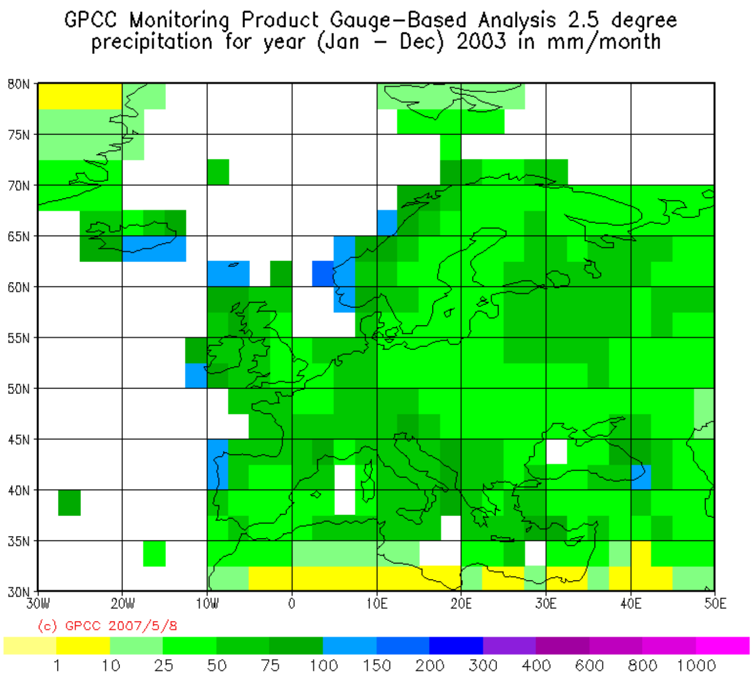


Figure 30: Global Precipitation Centre Product Gauge-Based Analysis
Source: Global Precipitation Centre (GPCC), Accessed May 2007. www.ded.de

4.3.8 Ground Vegetation

Ground Vegetation data are only sampled every 3 years. Consequently, the number of plots with data for 2002 is relatively low compared to other annual surveys. Data from the Ground Vegetation survey is shown on two maps.

- The first shows the plant species richness as the number of reported species over all layers (tree, shrubs, herbs and mosses) and surveys per plot in a specific reporting year. If a particular species code is submitted more than once per plot and year it is included only once. Resulting numbers are grouped and mapped using the following classes:

  <20, 20-40, 41-60, 61-80, >80 species.

- The second map presents changes in species richness per plot compared to the most recent previous survey. Results are grouped into the following classes:

  <-10, <-2, < +2, <+10, > +10 species.

The classification of the groups allows distinguishing between plots and regions in which an increase of species numbers was observed and those where the number of species decreased.

The comparison between the number of species per plot in the reporting year with that observed in previous years should not yield extreme differences. Any changes in number or species composition of ground vegetation may indicate natural disturbances or management effects as well as errors in data submission. Extreme changes need to be followed by the validating expert.

The plant species richness as the number of reported species over all layers (tree, shrubs, herbs and mosses) and surveys per plot in the year 2003 is mapped in Figure 31. For the plots located in Belgium, the Czech Republic and Finland predominately up to 40 species per plot were assessed. In Finland also some plots ranging from 41 to 80 species can be found. The variability and number of species is higher for plots in Norway, Switzerland, Hungary and Italy ranging from 21 to 80 species. For one plot in Switzerland and three plots in Italy above 80 species per plot were observed. However, the distribution of plant species diversity for Level II plots is in accordance with the general pattern of lower species number in Central and North Europe in contrast to high species richness in the Mediterranean regions.

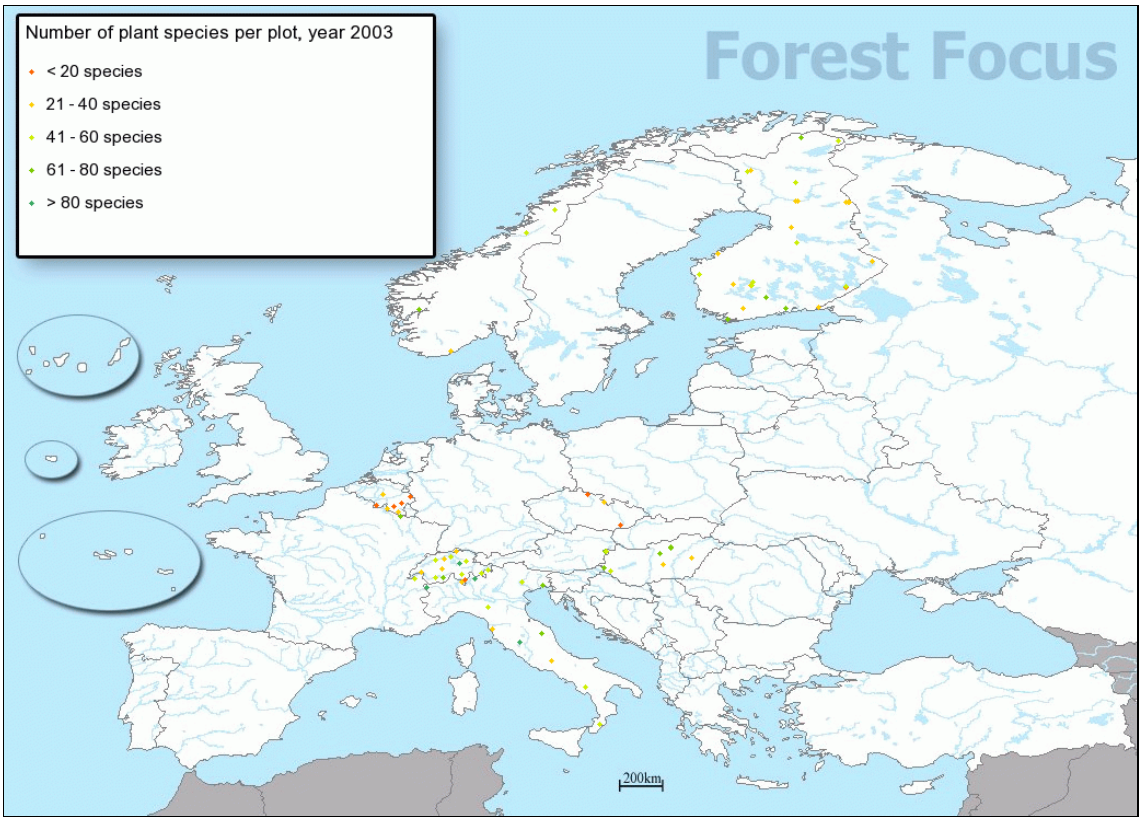


Figure 31: No. of Plant Species per Plot

Changes in the number of species reported are presented in Figure 32. For plots located in Belgium, Switzerland, Czech Republic and Italy as well as for three plots in Hungary a decreasing number of species is reported. For plots is Finland, Norway and Hungary an increase in species richness per plot ranging between -2 and +10 species were found. For the Finish plots and one plot in Switzerland and Hungary each above 10 species were observed. In 2003 Finland has established the new Common Sample Area (CSA) for ground vegetation assessment. Thus the plot size increased from 32m² in former years up to the new European standard of 400m². According to the species area relationship also the number of species has increased significantly in 2003.

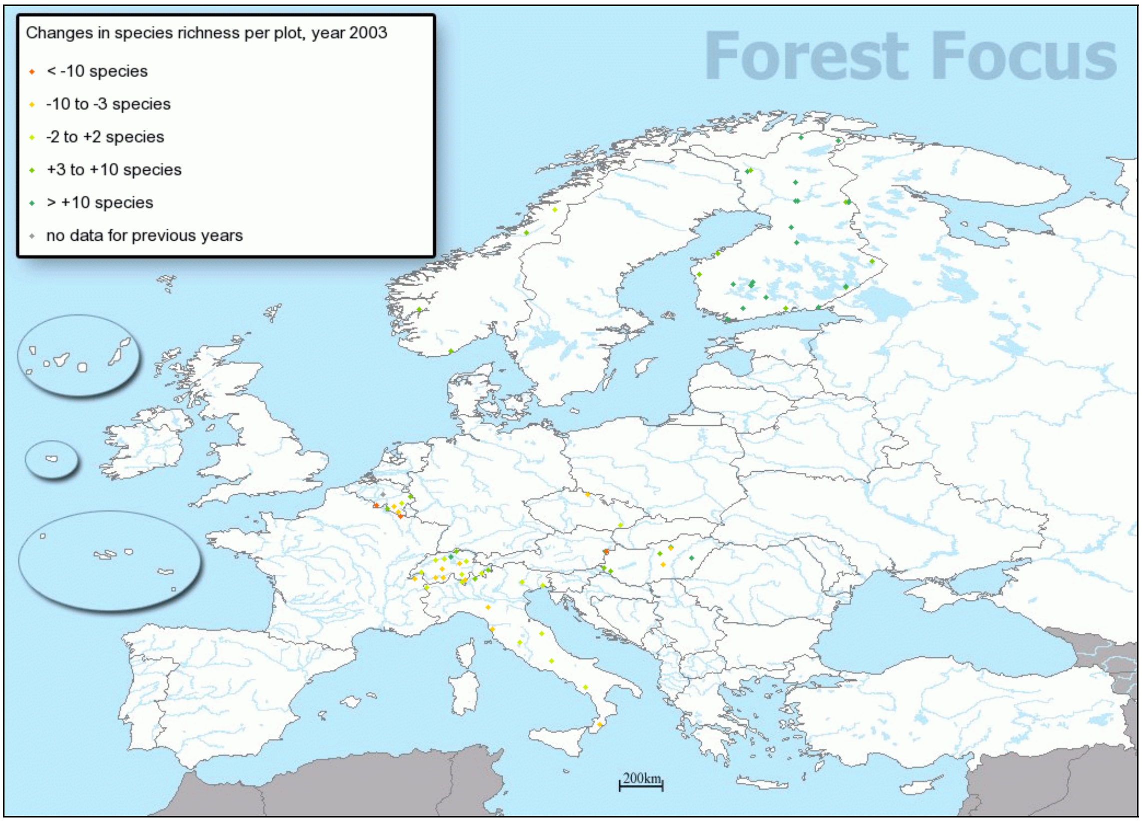


Figure 32: Change in Species Richness per plot

4.3.9 Air Quality

Uniformity of Air Quality data is checked by the time-weighted average concentration of O_3 per plot in a specific reporting year. Included are data for all plots for which data were submitted for at least 200 days. Ozone concentrations are grouped into the following classes:

<30, 30-45, 46-60, >60 ppb.

In the interpretation of the result specific attention is given to extreme values in relation to values of surrounding plots, taking into account the general increase in O_3 concentrations with decreasing geographical latitude. Comparing plot data with external data could assist the analysis of the data.

As shown in Figure 33 average ozone concentrations assessed in 2003 can be found for plots in the United Kingdom and the Mediterranean region. For the Level II plots in the United Kingdom, Spain and Italy the O_3 concentrations range between below 30 ppb to 45 ppb. Two plots in Luxembourg and Bulgaria show values ranging between 30 ppb and 45 ppb. The ozone concentrations observed in Switzerland are higher and range between 46 ppb and above 60 ppb. The concentrations measured on Level II plots in the United Kingdom and in Spain are similar to those concentrations reported by ICP Forests (Fischer *et al*., 2005) during the period April to September 2003. Moreover the

ICP Forests data show a gradient of increasing ozone concentrations towards the south which is particularly pronounced in the warm and sunny year 2003. The highest ozone concentrations reported by ICP Forests for 2003 are located in Italy. Against this background, the low ozone concentrations in Italy shown in Figure 33 are unexpected.

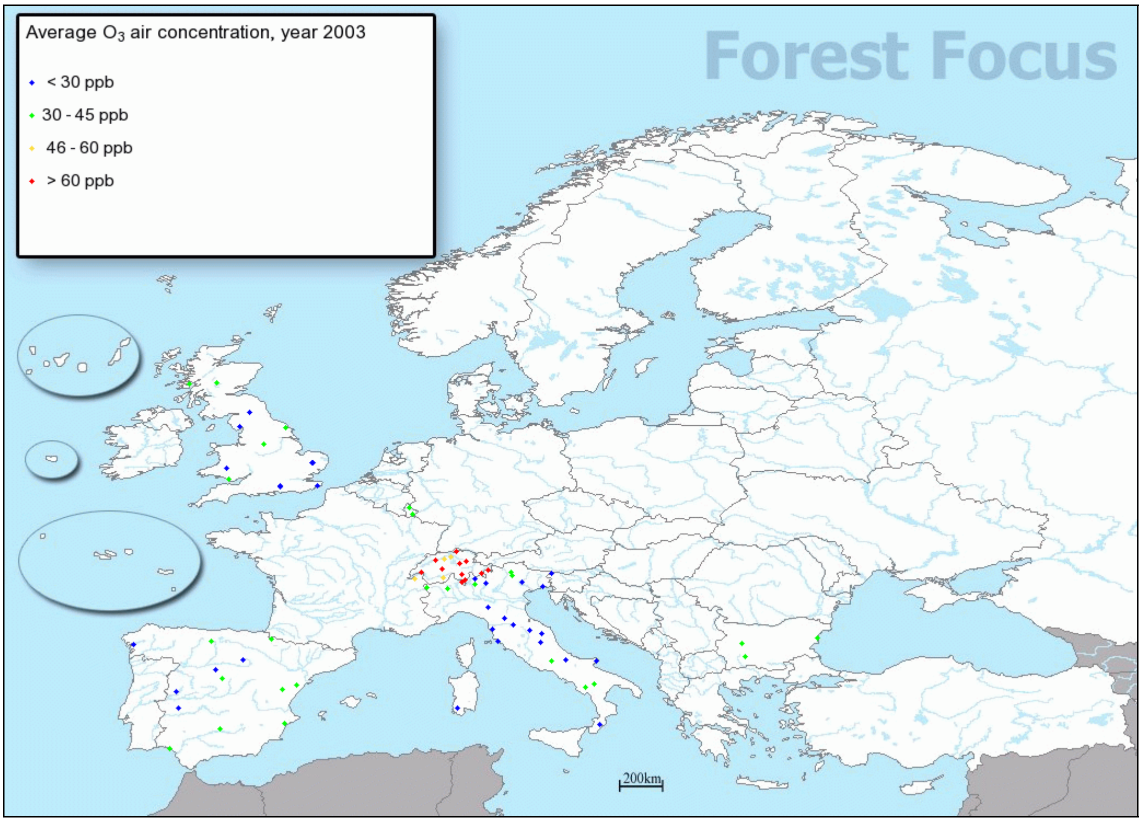


Figure 33: Average O_3 Air Concentration

4.3.10 Visible Ozone Induced Injury

Data from the survey of Visible Ozone Induced Injury are validated by means of a table rather than by a map. A map is not expected to show spatial patterns of injury because of the selective nature of positioning plots and because of the influence of local topographic conditions. In fact, the results given in the table confirm that a map would not have shown any spatial patterns. However, time series of observations should be established for identical plots in order to detect potential changes in visible ozone induced injury.

Table 5 contains the total number of those plots of the main tree species for which data on the parameter "percentage of symptomatic leaves/needles" was submitted by the countries. The table also contains the number of plots on which signs of ozone induced visible injury on trees were observed. A plot counts as injured if more than 5% of the leaves/needles of its trees show visible ozone injury.

Table 5: Number of plots with visible ozone injuries

Main Tree Species Prone to Ozone Injury	Total No. of Plots with Ozone Injury Assessment	No. of Plots with Ozone Injury Reported
Alnus glutinosa	1	0
Fagus sylvatica	6	0
Fraxinus excelsior	3	0
Picea abies	3	0
Pinus sylvestris	6	0
Quercus robur	5	0

For the survey year 2003, France, Hungary, Spain and Switzerland submitted data. All that data passed the conformity checks. On the plots, where ozone injury surveys were performed, a total of six different tree species were assessed for damage. No symptoms of damage by ozone were reported for any of the trees evaluated.

4.3.11 Phenology

Data from the Phenology survey are checked for uniformity by mapping the dates reported for the time of flushing (Event Code 1) and the dates reported for needle / leaf fall (Event Code 3). The dates are mapped when data for 50 or more plots are available. This was not the case for the 2003 monitoring period.

4.3.12 Litterfall

For Litterfall the parameters of the dry weight (kg/m^2), the mean content of C (mg/g) and N (mg/N) are used, as reported in the LFM form. The dates are mapped when data for 50 or more plots are available. This was not the case for the 2003 monitoring period.

4.4 Data Stored in Forest Focus Monitoring Database

A summary of all surveys successfully validated for 2003 monitoring year and transferred to the FFMDb is given for each survey per country in Table 6. In total 108 surveys from 24 countries (112 surveys from 25 NFCs) could be uploaded into the FFMDb. Relative to the number of surveys submitted the upload rate is 74%. This is a marked increase over 2002, when 79 surveys from 21 countries could be declared fully validated and uploaded into the FFMDb. In 40 cases the surveys were uploaded despite the identification of warnings or errors during the Conformity Check after clarification from the respecting NFC. As result of the combination of validation by Conformity and

Uniformity Check and the NFC requests for checking the Conformity results, all submitted surveys could be transferred to the FFMDb for the following countries: Estonia, France, Greece, Italy, Luxembourg, Norway and Sweden. No survey could be uploaded into the FFMDb for Poland.

Table 6: Surveys Uploaded to the FFMDb after Validation Checks (2003 Monitoring Year)

Country	Survey													Rel.
	SI	CC	SO	SS	FO	GR	DP	MM	GV	PH	AQ	OZ	LF	%
Austria		✓												20.0
Belgium	✓	✓		✓			✓	✓	✓					91.7
Bulgaria	✓	✓	✓	✓	✓						✓		✓	70.0
Cyprus														
Czech Republic	✓								✓					28.6
Denmark	✓	✓		✓	✓								✓	71.4
Estonia	✓	✓		✓	✓		✓							100
Finland		✓		✓	✓		✓	✓	✓					100
France		✓		✓		✓	✓	✓		✓		✓	✓	100
Germany	✓													12.5
Greece	✓	✓		✓	✓		✓	✓						100
Hungary		✓			✓		✓		✓			✓		71.4
Ireland	✓	✓			✓									50.0
Italy	✓	✓		✓	✓		✓	✓	✓		✓			100
Latvia														
Lithuania				✓			✓							66.7
Luxembourg		✓			✓		✓	✓		✓	✓		✓	100
Netherlands					✓									25.0
Norway		✓		✓	✓		✓		✓					100
Poland														0.0
Portugal														
Romania	✓						✓			✓				50.0
Slovenia														
Slovak Republic		✓					✓							66.7
Spain		✓		✓		✓	✓	✓		✓	✓	✓		100
Sweden		✓		✓			✓	✓						100
Switzerland		✓		✓	✓		✓	✓	✓		✓	✓		100
United Kingdom	✓			✓			✓	✓			✓			71.4
Total	11	17	1	14	12	2	16	10	7	4	6	4	4	74.0

Most of the surveys loaded were for Crown Condition (17), Deposition (16) and Soil Solution (14) and Meteorology (10). Soil Condition analysis should be submitted only every ten years, so in only one case data were submitted for the monitoring year 2003 and stated conform and uniform and accordingly pushed into the FFMDb.

Conformity and Uniformity Checks include the analysis of time series for several parameters. A consequence of establishing time-series for the current validation process is that surveys with an annual observation interval, such as Crown Condition, must be available in a compliant and conform status at least for the years 2001, 2002 and 2003. This requirement has limited the amount of data available for validating data for uniformity. But at least for Crown Condition the time series are mostly complete. Data from 2001 had to be used for validating 2003 data whenever no valid 2002 data exist.

4.5 Specific Validation Problems

4.5.1 Fixed-Format Data Files

The data exchange format with fixed positions and defined length of values was found to be susceptible to storing a parameter in the wrong position in the file. The fixed format is also quite inflexible when changes in the units of observations occur or in cases of modifications to the list of parameters to be reported. The use of alternative formats was investigated. A comma-separated format was found to be more flexible than the fixed-format for recording figures with variable decimal places. However, the format is by no means standardized and problems are frequently encountered for storing dates. The comma-separated format would also require such an extensive definition of recording values that it would not actually represent the improvement needed to improve data format reliability. A format incorporating meta-information was found to be the preferable option and the XML format would appear a suitable improvement over the existing format.

4.5.2 Interpretation of Field Formats

Over the time the interpretation of the filed formats had to undergo a process of adaptations. Originally the interpretation of the formats was exactly as given in the specifications. After the first submissions of data it became obvious that some field dimensions were insufficient to hold the data reported. The previously suggested procedure to deal with such cases, i.e. fill the field with the maximum value and report the actual measurement in the comment field, places the actually measured value outside the range of standard analysis tools. Correspondingly, measurements too small to be recorded in the dimension of the field were frequently rounded to 0 or to the smallest recordable value. Those practices carry the risk of generating spurious results when computing summary statistics for a parameter and can invalidate relationships between parameters.

Using a fixed-format to record the data does not allow enlarging the fields without having an effect on the position of all subsequent fields in the form. Changing the field dimensions would also have to be transferred to the ICP Manuals to remain consistent in the specifications. The process is rather lengthy and would not have helped to manage the situation already at hand. The solution applied was to apply a more tolerant interpretation of the field formats. The modifications concern the position of the decimal point in float fields and the definition of some integer fields to allow float values to be stored in the fields.

- **Floating Decimal Point**

  The interpretation of the format for numerical values has been changed in July 2006 to allow more flexibility. In the initial tests the position of the decimal within the format specified was fixed. For example, a format of 99.9 could only hold values between 0.1 and 99.9. For some parameters it was found that the formats specified did not allow storing the measured value for certain parameters. As a consequence of using a fixed-format file definition a change in one area would affect all subsequent field positions. This problem was avoided by not controlling the position of the decimal point. This interpretation increases the storage capacity of a field by several orders of magnitude, but provides less intrinsic control over the values submitted. The VALUE_TOO_LONG and TOO_MUCH_DECIMAL errors should not occur, although the condition is still tested.

- **Integer Field with Float Option**

  The rules for the interpretation of integer values are:

  1. Discrete units (any “No. of...”) are tested as integer values.
  2. Numeric fields linked to a dictionary associated as integer values.
  3. All fields dimensioned as [99] remain integer values.

  4 All integer fields dimensioned >[99] are tested as float value, if not 1. or 2.

  For most fields defining a measured or observed parameter, the position of the decimal separator is indicative. As a consequence a filed defined as [99.99] can contain up to 5 digits. The range of values stretches from 0.001 to 99999.

  Should a value exceed the range of values set by the format specifier for a given field it is advised to verify the validity of the value before changing the specified position of the decimal separator. Values not conforming to the format specifications generally indicate a problem with the measurement units and only in rare cases the occurrence of an extreme event.

The interpretation of some integer fields as float was noticed also in the legacy data. When importing the legacy data the previous formats were maintained generally to 7 decimal places. No information was lost due to rounding or truncation during the transfer of the data to the FFMDb.

4.5.3 Use of Zero and -1 in Submitted Data

After the data submission of the monitoring year 2003 the situation of the use of zero and/or “-1” is still heterogeneous. 25 different NFC have submitted data from the soil solution and or from the deposition survey. For Soil Solution data 7 NFCs used a zero and 11 NFCs used “-1”. In the data forms of the Deposition survey 10 NFCs used a zero and 11 NFC used “-1” (see Table 7 and Table 8). In most cases the NFC chose either to use zero values or “-1”. Nevertheless six NFCs (Denmark, Germany, The Netherlands, Poland and Switzerland) used both values in one survey. Switzerland in particular indicates rounded values with zero where the value is still too high for a column even if using the floating format. In comparison to 2002 some NFCs like France and Italy followed the recommendation and renounced to use the zero. Instead “-1” was used to define values below the detection/quantification limit.

The reactions of the requests after the conformity checks where zero values and “-1” values triggered warning messages, which were asked to explain, were not complete. The highest ratio of explanations was given for the use of “-1” values of the Deposition and Soil Solution data (Table 7). As expected Seven NFCs stated as expected that “-1” were used as a code for 'below detection/quantification limit'. Values of "-1" values were not used with any other meaning. For all remaining cases without an explanation, it is very likely that “-1” is also used in the same way, because it is a valid code according to ICP Forests Manual.

Table 7: Use of -1 in Data Forms of the Soil Solution and Deposition Survey in 2003

NFC	Soil Solution			Deposition		
	used '-1'	Reaction from NFC	Code for '*below detection limit*'	used '-1'	Reaction from NFC	Code for '*below detection limit*'
Austria	n			n		
Belgium (VL)	y	n	y	y	y	y
Belgium (WA)	y	y	y	y	y	y
Bulgaria	n			n		
Czech Republic	y	n	?	y	n	?
Denmark	y	y	y	y	n	?
Estonia	n			n		
Finland	y	y	y	y	y	y
France	y	y	y	y	y	y
Germany	y	n	?	y	n	?
Greece	n			n		
Hungary	N.S.			n		
Ireland	n			n		
Italy	y	y	y	y	y	y
Lithuania	n			n		
Luxembourg	N.S.			n		
Netherlands	y	n	?	n		
Norway	n			n		
Poland	N.S.			y	n	?
Romania	N.S.			n		
Slovak Republic	N.S.			n		
Spain	n			n		
Sweden	y	y	y	y	y	y
Switzerland	y	y	y	y	y	y
United Kingdom	n			n		
Total	**11**	**7**	**8**	**11**	**7**	**7**

Explanations from NFC after request:
y = yes, n= no, N.S. = Not submitted, ? = no information

The use of zero values in the submitted data remains unclear in many cases. For Soil Solution only five from seven NFC reacted on the data request for the respecting survey, but in only two cases a sufficient explanation were given to warnings triggered by zero values: Switzerland and Norway used in 2003 zero values to indicate rounded values, as presented in Table 8. For file formats which were valid in 2003 (fixed number of decimals) extreme low concentrations could be rounded to zero.

Table 8: Use of zero values in data forms of the Soil Solution and Deposition Surveys in 2003 and Explanations from NFCs

NFC	Soil Solution			Deposition		
	used '0'	Reaction from NFC	Meaning	used '0'	Reaction from NFC	Meaning
Austria	y	n	?	y	n	?
Belgium (VL)	n			n		
Belgium (WA)	n			n		
Bulgaria	n			y	n	?
Czech Republic	n			n		
Denmark	n			y	n	?
Estonia	n			n		
Finland	n			n		
France	n	n		n	n	
Germany	y	n	?	y	n	?
Greece	n			n		
Hungary	N.S.			n		
Ireland	y	n	?	y	n	?
Italy	n			n		
Lithuania	n			n		
Luxembourg	N.S.			y	y	?
Netherlands	y	n	?	y	n	?
Norway	y	y	?	y	y	R.V.
Poland	N.S.		R.V.	y	n	?
Romania	N.S.			n		
Slovak Republic	N.S.			n		
Spain	n			n		
Sweden	n			n		
Switzerland	y	y	R.V.	n		
United Kingdom	y	y	?	y	y	?
Total	**7**	**3**	**2**	**10**	**y**	**1**

Explanations from NFC after request:
y = yes, n= no, N.S. = Not submitted, R.V. = rounded value, ? = no information

A very similar situation could be found in the Deposition data. Only three from 10 NFCs which have used zero values in the data files (DEM, DEO and DEA) gave explanations to the warnings and error messages found in the Conformity Check report for deposition. In addition to the explanations given by Norway, which are also valid for data of the Deposition survey, Luxembourg and the United Kingdom just stated the correctness of the data without an explanation of the meaning of zero values.

No questions remain for the treatment of missing data or low values for the following 15 NFCs, which have submitted Deposition and/or Soil Solution data: Estonia, Finland, Flanders, France, Greece, Hungary, Italy, Lithuania, Norway, Poland, Romania, Slovak Republic, Spain, Sweden, Switzerland, and Wallonia.

4.5.4 Recommendations for Treatment of Missing Measurement Values

The representation of missing data should be addressed by the Expert Panels and specific guidelines should be adopted and included in the ICP Manual. In the absence of such guidelines THE JRC has developed specific rules for treating zero values in data submitted by NFCs for monitoring periods from 2002 onwards.

- **Classification of Missing Data**

  For the purpose of the data validation procedure, missing data are entries recorded in the data files in the reporting forms, which do not represent valid measurements or observations for a given parameter. Missing data can occur due to a given parameter not collected, not usable or lost. The validation process is not concerned with missing data, which are not recorded in the data files, e.g. the completeness of periodic measurements. Furthermore, issues of randomly or systematically missing data are not treated.

  The ICP Forests Manual mentions the coding of "missing data" in several places, for example for the data recorded in the forms SOM, SOO, SSM, SSO, FOO, DEM, DEO, DEA, LFM, LFO. The ICP Forests Manual identifies two cases of data being measured / observed, but at levels which cannot be represented in the field formats. Depending on the condition, recording the data in the forms is treated differently. A valid measured value may be either too small or too large to fit the field format. Both conditions frequently occur for several parameters.

- **Recommendations**

  The general approach to treating "missing data" in the validation process of the Forest Focus Monitoring Database has to take the properties of the legacy data into account as well as the variety of treatment of "missing data" by NFCs. The validation process is therefore based on the identification of valid values for measured or observed parameters. In this the approach differs profoundly from the identification of codes signifying missing data.

  The recommendations presented are given below, separated by the situations to which they apply:

  a. *Measured, but outside field specifications*

  - **Value too small for format specified for field**

    A measurement of a value should be recorded as measured, shifting the decimal point as needed. Data should not be rounded except where shifting the decimal point is still insufficient to record the measured value. For example, the format for recording N-NO_3 in the Soil Solution survey specified as 999.9. A measured value of 0.03 should be recorded as such. In the example given rounding should only be applied for values <0.001.

- **Value too large for field format**

  A measurement of a value should be recorded as measured without the decimal part. For example, alkalinity in the soil solution at times exceeded 999.9µmolc/l. A value of 1500 should be recorded as such in the field. Data should not be entered into the field “Other observations”.

b. *Measured, but below limits of detection for instrument*

The use of -1 for a measurement is defined to code a value below the detection limits of the instrument used. This condition occurs frequently in soil solution data. The values should not be rounded, interpolated or marked by a zero entry.

c. *No Measurement*

The field should be left empty. The condition should **not** be coded by using a zero entry, although this is sometimes recommended.

Cases a. and b. have been largely eliminated. The decimal point in the format is no longer tied to a fixed position. A format specified as 999.9 can hold values from 0.001 to 99999. It would have been preferable to adjust the field dimension in the format specifications. However, the process of modifying the specifications is lengthy and would not solve actual problems.

All data not considered valid measurements are highlighted in the reports as either warnings or errors. The NFCs are given the opportunity to consider the values reported and can confirm the values or re-submit modified data.

4.5.5 Field Links in Air Quality Survey

Contrary to other Surveys the Air Quality survey uses two plot forms (PAC, PPS) and a single data form (AQM) to record active and passive sampler observations. The forms containing the plot information (PAC, PPS) form should only contain a unique combination (records, lines) for entries in the following fields:

[Country_Code]-[Station]-[No._Active_Sampler]

It is strongly recommended to number all samplers at a station consecutively and not to use the Compound Air Quality field as part of the combined key. Each compound measured at a station thus receives an individual code for the active sampler. It is not necessary to sequentially code the active samplers for all stations, they can be renumbered for each station.

In the AQM form the combination of [Country_Code]-[Station]-[No._Active_Sampler] has to be used to link the data to the information of the PAC form. Because the link only uses three fields it is required to use only those fields in the PAC to form a unique combined key and not rely on the entry for the Compound Air Quality.

An example of recording data from active samplers is given in Figure 34.

Sequence number (1–4)	5	Country code (6–7)	8	Station with permanent air quality measurements (SXXXX) (9–13)	14	Number of active sampler (active sampler =ASXXX) (15–19)	20	Compound air quality (21–23)	24	Latitude (25–30)	31	Longitude (32–37)	38	Altitude (39–40)	41	Vegetation at plot (codes to be determined) (42–43)	44	Inlet height (m) (45–48)	49	Site classification (code obtained from) (50–51)
0001		88		S0004		AS001		NO2		543210		067890		01						
0002		88		S0004		AS002		O3		543210		067890		01						
0003		88		S0007		AS001		NO2		654321		056789		02						
0004		88		S0007		AS002		SO2		654321		056789		02						
0005		88		S0007		AS003		O3		654321		056789		02						

LINK

LINK

Corresponding codes

Sequence number (1–4)	5	Country code (6–7)	8	Observation plot number (XXXX) or station number (SXXX) (9–12)	13	Number of active or passive sampler (active sampler = ASXXX, passive sampler = PXXX) (14–18)	19	Start date measurement periods (20–25)	26	End date measurement periods (27–32)	33	Variable code (34–39)	40	Variable value (41–46)	47	Other observations (text) (48 … …)
0001		88		S004		AS001						NO2_MC				
0002		88		S004		AS001						NO2_MC				
0003		88		S004		AS001						NO2_MC				
0004		88		S004		AS002						O3_MC				
0005		88		S004		AS002						O3_MC				
0006		88		S004		AS002						O3_MC				
0007		88		S007		AS001						NO2_MC				
0008		88		S007		AS001						NO2_MC				

Figure 34: Linking Fields between Forms of Air Quality Survey

The coding of data for passive samplers is analogous. The forms containing the information on the plot (PAC and PPS) repeat some of the information of the plot characteristics when the location of the samplers coincides with the observation plot.

5 SUMMARY AND RECOMMENDATIONS

Data collected by the surveys of 2003 were submitted by NFCs and validated by the JRC according to the stipulations of Forest Focus. The regulation instigated substantial changes from the procedures used during the previous scheme for monitoring conditions of the forest environment in the field of data management of information collected on the intensive monitoring plots. The 2003 data had to be submitted together with the 2002 and 2004 data at the end of December 2005. With respect to the measurement methods and the submission format specifications some of the surveys differed between years. Together with the new data management under Forest Focus this has led to a not inconsequential amount of uncertainty regarding the data submission procedure.

With the introduction of Forest Focus the whole data management process was restructured and made more transparent to NFCs. A web-based data submission module allows full control of NFCs over which data to submit from the desktop computer. The process removes all inconveniences of managing data on physical storage. The option of on-line checks of data Compliance helps NFCs to identify problems in the data format with an immediate response of the system before the surveys are submitted. The module further allows retrieving information of previously submitted files for all years. An option for listing all submissions by year, survey, date and status helps NFCs to ascertain what has been submitted when and which status was obtained.

The tests for data Conformity revealed several problems with the formats and dimensions for the measurement fields. The main problem was that the specified data formats were not always sufficiently adapted to recording the observations. When using a strict interpretation of the field specifications for reporting values in the forms, extreme values, both small and large, could not be stored properly. As a consequence of the fixed-format files the fields could not be adjusted without changing the position of all subsequent fields. The option given in the ICP Forests Manual of coding such situations and storing the values as text in the field reserved for commenting any observations was rejected as unsuitable, because the data values would effectively be lost from calculations made on the parameter or lead to inaccurate summary statistics. Eventually, the problem could be solved by using a more flexible interpretation of the field format and not fixing the position of the decimal point in the field format. This solved all problems of recording valid measurements. Another problem encountered at the stage of checking data conformity was the coding of non-valid measurements. No proper and defined guidelines were commonly applied to reporting missing data or data outside the measurement range of the instrument used. A set of instructions were therefore communicated to NFCs on how to deal with those cases, which were based on the guidelines of the ICP Forests Manual.

The experience of the data submission for Level II demonstrated the need for a data quality procedure to be applied and that the process should be automated to provide more consistent results. Despite the degree of automation achieved not all cases can be covered in guidelines, and communication with data providers is a very important part of the validation process. A multitude of additional queries could be solved in direct communication with NFCs.

For the submission of 2003 data two main periods of opening the DSM were provided to NFCs, the last from 26.03. to 06.04.2007. On several occasions the site had to be opened to allow corrected data for individual surveys to be submitted. For the monitoring year of 2003 a total of 151 surveys were submitted by 25 NFCs. The intensity of data submissions for the 13 surveys ranges from 1 for Soil Condition to 25 for Crown Condition and Deposition. Of all surveys submitted 59 (39%) were tested OK for Compliance. Tested with warnings were 93 surveys (61%). None of the surveys generated error messages and, consequently, all submitted surveys could enter the next validation stage of the data Conformity Check.

The results obtained from the Conformity and Uniformity Checks demonstrated the usefulness as well as the need of the checks. Detected were a large number of extreme values, potential errors, temporal inconsistencies or impossible values in the submitted data. The checks of the submitted compliant data revealed that in 20% of the 2590 performed tests, situations generating warnings or errors were found by the routines. During subsequent communication with the NFCs the data quality could be significantly improved. NFCs corrected erroneous data and re-submitted the surveys concerned or could verify the validity of data found outside the limits of range tests. At the end of the validation of the 2003 monitoring year, out of the 151 surveys submitted by 25 NFCs, 112 surveys from 24 NFCs could be fully validated and uploaded into the FFMDb.

The main reason for the failure of the remaining surveys to pass the validation process stems from the errors generated when testing values for temporal consistency. Whenever there is no validated data from a previous survey the 2003 data could not be validated for temporal consistency and had subsequently to be declared non-validated, albeit all other aspects of the data were found to be correct. . For the static parameters concerned the new values only need to be declared correct by an NFC in order to complete the validation process. In case validated data from a previous survey exist and the test on temporal consistency revealed a change, such as changes in site coordinates, the NFC is required to verify and correct the situation.

Most of the warnings generated by the various tests for Conformity were found in the data of the Meteorological survey. The warnings were largely caused by values outside the expected ranges or by the use of data forms for optional data for mandatory parameters. Errors mainly related to changes in presumed constant parameters, such as the occurrence of new trees on the plots, the change of species determination of the same tree individuals or changes in plot coordinates or altitude. Anomalies from the general trend, e.g. shrinking trees, could usually be declared extreme events.

A different condition provoking errors was the coding of missing data and values below the detection/quantification limits; in particular the use of a zero value to indicate the absence of a measurement. Particularly affected from ambiguous entries in parameter fields were data submitted for the Soil Solution and Deposition surveys. The recommendation elaborated for submitting Forest Focus data is to use “-1” to record measurements below the detection limit of the equipment. In case of missing data the corresponding entries should be left blank. An entry of zero in a field for a measured parameter should indicate a valid measurement whose value is effectively zero, e.g. no precipitation positively recorded. Some very low values rounded to zero when the stated number of decimal places was applied. It is recommended in these cases to use more decimal places to record the value as long as this does not exceed the precision limit of the equipment used.

The tests for Uniformity include mapping the available data for a visual interpretation by experts in the fields of the spatial distribution of the measurements. Some of the parameters tested are also mapped to show the consistency of temporal trends between plots. Data from ancillary sources of information, such as Level I plots and EMEP, can be used to support the validation of the values.

In order to further improve the quality of the data submitted for Level II plots the recommendations based on the experience of the validation of 2003 survey data are basically identical to those given after the validation of 2002 data. They are summarized as follows:

- The existing data format specifications as published by the JRC for a given monitoring year should be followed closely.
- Missing data and measurements below the detection limit of the instrument used should be coded according to the guidelines provided. Never use zero to indicate a missing measurement for non-categorical parameters.
- The data formats in use should be revised by the Expert Panels in charge of the various parts of the ICP Forests Manual with respect to the dimensions of the fields used.
- For future revisions of the forms specified in the ICP Forests Manual it is strongly recommended that particular consideration is given to the efficient transfer of the information recorded on the survey forms to the database.
- Any changes to the monitoring setup or instruments used should be documented in DARs.
- NFCs should verify their data after having received the Conformity Status reports and react in case any messages are generated. Without confirmation from NFCs any ambiguous data will not be transferred to the database.

The results obtained from the validation activity and presented in this report are encouraging with respect to the extension of the number of surveys performed on Level II plots and the improvements made in the quality of the data submitted over 2002. Data collected under Forest Focus continues in most cases seamlessly from the data collected under the previous monitoring scheme. However, in any analysis of the data specific attention should be given to the treatment of missing data or to measurements below the detection limit of the instrument used.

BIBLIOGRAPHY

Augustin, S., W. De Vries, C. Müller-Edzards, K. Stefan and L. Vanmechelen (1997) Forest Condition in Europe. Executive Report 1997. UN/ECE and EC, Geneva and Brussels, 41 p.

Augustin, S., A. Bolte, M. Holzhausen and B. Wolff (2005) Exceedance of critical loads of nitrogen and sulphur and its relation to forest conditions. European Journal of Forest Research, 124 (4), p. 289-300.

De Vries, W., G. J. Reinds, C. van der Salm, G.P.J. Draaijers, A. Bleeker, J.W. Erisman, J. Auee, P. Gundersen, H.L. Kristensen, H. Van Dobben, D, De Zwart, J. Derome, J.C.H. Voogd and E.M. Vel (2001) Intensive Monitoring of Forest Ecosystems in Europe. Technical Report 2001. UN/ECE and EC, Geneva and Brussels, 177 pp.

De Vries, W., G.J. Reinds, H. van Dobben, D. de Zwart, D. Aamlid, P. Neville, M. Posch, J. Auée, J.C.H. Voogd and E.M. Vel (2002) Intensive Monitoring of Forest Condition in Europe: Technical Report 2002. UN/ECE and EC, Geneva and Brussels, 175 pp.

De Vries, W., G.J. Reinds, M. Posch, M.J. Sanz, G.H.M. Krause, V. Calatayud, J.P. Renaud, J.L. Dupouey, H. Sterba, E.M. Vel, M. Dobbertin, P. Gundersen, J.C.H. Voogd. (2003) Intensive Monitoring of Forest Ecosystems in Europe. Technical Report 2003. UN/ECE and EC, Geneva and Brussels, 161 pp.

European Commission (ed) (2007). Forest Focus Monitoring Database System – Technical Specifications 2002 Level II Data. EUR 22718, Office for Official Publications of the European Communities, Luxembourg. 99 p.

European Commission (ed) (2005) Forest Focus Monitoring Database System – 2002 Data Submission Report. JRC, Institute for Environment and Sustainability, Ispra, Italy. 41 p.

Hiederer, R., T. Durrant, O. Granke, M. Lambotte, M. Lorenz and B. Mignon (2007a). Forest Focus Monitoring Database System – Technical Report 2001 Level II Data. EUR 22782 EN. Office for Official Publications of the European Communities, Luxembourg. 129 pp.

Hiederer, R., T. Durrant, O. Granke, M. Lambotte, M. Lorenz, B. Mignon and K. Oehmichen (2007b). Forest Focus Monitoring Database System – Technical Report 2002 Level II Data. EUR 22875 EN. Office for Official Publications of the European Communities, Luxembourg. 142 pp.

Lorenz, M., V. Mues, G. Becher, W. Seidling, and R. Fischer (2001) Forest Condition in Europe. 2001 Technical Report. UN/ECE and EC, Geneva and Brussels, 103 pp.

Lorenz, M., V. Mues, G. Becher, W. Seidling, R. Fischer, D. Langouche, D. Durrant and U. Bartels (2002) Forest Condition in Europe. 2002 Technical Report. UN/ECE and EC, Geneva and Brussels, 160 pp.

Lorenz, M., V. Mues, G. Becher, C. Müller-Edzards, S. Luyssaert, H. Raitio, A. Fürst and D. Langouche (2003) Forest condition in Europe. 2003 Technical Report. UN/ECE and EC, Geneva and Brussels, 113 pp + Annexes.

Lorenz, M., V. Mues, G. Becher, R. Fischer, E. Ulrich, M. Dobbertin and S. Stofer (2004) Forest condition in Europe. 2004 Technical Report. UN/ECE and EC, Geneva and Brussels, 113 pp + Annexes.

Lorenz, M., G. Becher, V. Mues, R. Fischer, R. Becker, V. Calatayud, N. Diese, G.H.M. Krause, M. Sanz and E. Ulrich (2005) Forest Condition in Europe. Technical Report 2005. UN/ECE, Geneva, 99 pp + Annexes.

Lorenz, M., R. Fischer, G. Becher, V. Mues, W. Seidling, P. Kraft and H-D. Nagel (2006) Forest Condition in Europe. Technical Report 2006. UN/ECE, Geneva, 113 pp + Annexes.

Nigot, S., B. Mignon and R. Hiederer (2006) Forest Focus Monitoring Database System – Submission Module User Manual. EUR 22184 EN, Office for Official Publications of the European Communities, Luxembourg. 29 pp.

Ouimet, R., L. Duchesne, D. Houle, P. A. Arp (2001) Critical loads and exceedances of acid deposition and associated forest growth in the northern hardwood and boreal coniferous forests in Québec, Canada. Water, Air, and Soil Pollution: Focus 1: p.119-134.

European Commission

EUR 22905 EN/1 – DG Joint Research Centre, Institute for Environment and Sustainability

Title: Forest Focus Database System - Technical Report 2003 Level II Data

Authors: Hiederer. R. T. Durrant, O. Granke, M. Lambotte, M. Lorenz. B. Mignon, K. Oehmichen

Luxembourg: Office for Official Publications of the European Communities
2007 – 88 pp. – 21 x 29.7 cm
EUR - Scientific and Technical Research series; ISSN 1018-5593

Abstract

Forest Focus (Regulation (EC) No 2152/2003) is a Community scheme for harmonized, broad-based, comprehensive and long-term monitoring of European forest ecosystems. Under this scheme the monitoring of air pollution effects on forests is carried out by participating countries on the basis of the systematic network of observation points (Level I) and of the network of observation plots for intensive and continuous monitoring (Level II).

According to Article 15(1) of the Forest Focus Regulation Member States shall annually, through the designated authorities and agencies, forward to the Commission geo-referenced data gathered under the scheme, together with a report on them by means of computer telecommunications and/or electronic technology. For managing the data JRC has implemented a Forest Focus Monitoring Database System.

This Technical Report presents the results obtained from all processing stages (data reception, validation checks – compliance, conformity, uniformity) for submitted data referring to the monitoring year 2003. This report presents the results at the end of the processing phase after data have been re-submitted in 2007. It presents in addition a brief comment on the data status for each NFC, for the reporting year, with respect to the parameter assessed and including analyses of spatial variability of data and temporal trends of parameters.

MISSION OF THE JRC

The mission of the Joint Research Centre is to provide customer-driven scientific and technical support for the conception, development, implementation and monitoring of European Union policies. As a service of the European Commission, the Joint Research Centre functions as a reference centre of science and technology for the Union. Close to the policy-making process, it serves the common interest of the Member States, while being independent of special interests, whether private or national.

JRC
EUROPEAN COMMISSION

Publications Office
Publications.eu.int